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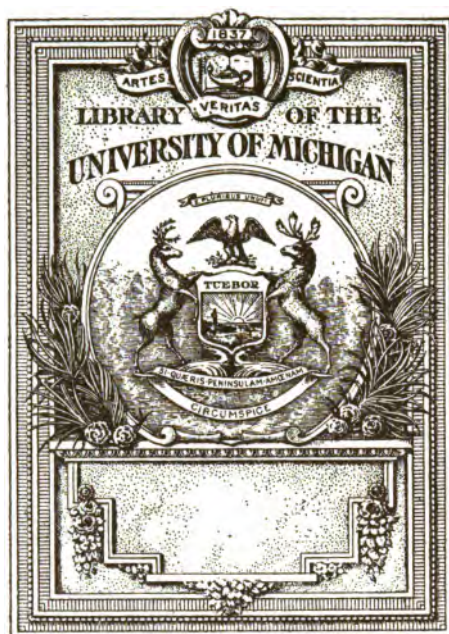
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# STATISTICAL WORK

*A Study of Opportunities for Women*

THE BUREAU OF VOCATIONAL INFORMATION



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no. 2



# STATISTICAL WORK

*A Study of Opportunities for Women*

STUDIES IN OCCUPATIONS, NUMBER TWO

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## FOREWORD

**D**URING the past decade the profession of statistics has abruptly changed some of its most time honored characteristics. For nearly two centuries it had maintained a studious and somewhat secluded existence, with relatively few members, generally high standards, and a record of continuous achievement. Its members found their rewards largely in the satisfaction that comes from good workmanship and in the respectful recognition of fellow workers in their craft, for the material returns were of modest proportions.

In the past ten years much of this has changed. The number of statistical workers has greatly increased in countries throughout the world and the expansion of the profession has been especially rapid in the United States. This sudden growth has been largely due to the advent of the business statistician, but other clearly defined groups such as the economic statisticians, the educational statisticians, and the financial statisticians have grown to such proportions as to demand separate recognition and in some instances to form national organizations.

This increase in the numbers and importance of the profession is permanent, and further growth is certain. In this country the great war marked the end of the age of haphazard in business, financial, and governmental thinking. We have entered upon a long era of fundamental changes in economics, trade, and human relations. Under these new conditions people require a fact-basis for their thinking and their planning and in ever increasing measure they must turn to the statisticians for the interpretation and presentation of the new and unforeseen facts emerging on every hand and demanding attention.

Statistics is a method by which social facts are studied. It proceeds through the steps of analytic scrutiny, exact measuring, careful recording, and judgment on the basis of numerical evidence. In the past ten years its methods for dealing with its materials have been so greatly improved and extended that it can interpret conditions, measure relationships, and even venture into the field of prophecy, with an accuracy and definiteness that were formerly quite unattainable.

The present volume deals with opportunities for women workers in this field. They will succeed in direct proportion to

their abilities and their efforts. For women and for men alike, the profession of statistics offers a fair field and no favors. Neither fortune nor family connections, friends or personal charm can greatly avail the statistical worker in the achievement of success. Quality of workmanship is the one essential.

In striving for real attainment in statistics all beginners find one great barrier which must be passed if they are to secure any large measure of success. This is met in the transition from the clerical work of the apprenticeship period to the creative work of the real statistician.

It has already been stated that the method of statistics may recognize four steps or kinds of work—analytic scrutiny, exact measuring, careful recording, and judgment of the evidence. Most of the workers are permanently engaged in those portions which relate to the careful collecting, recording, and arranging of the figures on which the study is based. The remaining few do the work of analytic scrutiny and the formulation of the judgments of evidence. A majority of the workers tabulate the figures and draw the diagrams; a chosen minority interpret the results and present the conclusions.

As women enter the profession in increasing numbers they will find many opportunities for useful and congenial work at fair remuneration. These are the opportunities at what may be termed the clerical levels of the profession. There are other opportunities above these, that are not ready-made, but must be created. They carry with them possibilities of service and influence, and rates of remuneration that place them on the highest professional levels. These positions await those who create them.

The present volume is the first of its sort in the field of statistics. It describes the kinds of work to be done, tells how preparation may be secured, and outlines the conditions that the new worker may expect to meet. Information and comment of these sorts are of the first value. The whole profession, as well as the newest workers entering it, owes a debt of gratitude to those who have produced this book. It is to be hoped that its publication will aid in bringing into the profession of statistics many well-trained young women equipped with aptitude and ambition. They will find a welcome in a profession that is rapidly growing, in which many of the methods are new, and most of the workers are young, and which has immediately before it the promise of noteworthy achievement in a hundred different fields of science, finance, business, education, and government.

LEONARD P. AYRES.

August, 1921.

## INTRODUCTION

**T**HIS report forms one in a series of studies of occupations made by the Bureau of Vocational Information in connection with its continuous efforts to find and disseminate the facts concerning the work of trained and educated women.

The old time struggle of women for equality of educational opportunity, followed by the long and earnest striving for political equality, will soon give place to concentrated effort in the direction of clarifying and justifying women's economic status. The professional and occupational doors are not yet wide open to women, economic prejudice is still being nourished, salaries are far from equal, and women are still looked upon as too unstable and uncertain a factor in business and in the professions to justify encouragement or to merit advancement in all lines.

It is only by careful discovery and consideration of the facts that we can reach any solution for the unsettled question as to the economic position of women. In what types of work do the opportunities for women exist, in what lines are women to be found; what is the nature and quality of their work and what is their attitude toward it; how important has been or may be their contribution in each field, what lies in the way of their advancement and what future have they in each; what is their earning capacity? These and other questions need to be answered for women in business and professional pursuits before their status can be clarified. The studies which the Bureau is making and publishing should supply answers to some of these questions and contribute facts for the solution of at least a part of this problem.

The present study of the opportunities for women in statistical work was inspired by the queries of many young women who were looking for a fact basis for occupational choices and whose talents and training led them to consider fields of work offering opportunity for research, requiring the handling and consideration of social or economic data, or depending upon mathematical ability. There is need, also, in a more general sense, of calling attention to the recent, rapid growth of statistical work as a science and to the professional and business status of men who have achieved distinction in this science. The officers of some of our great industrial and financial corporations are men whose value to their companies

has been developed and discovered in the statistical departments where every individual corporation activity, problem and expense has been analyzed. No limits have been set for the future of this work.

In connection with this study we acknowledge our great indebtedness to Dr. Leonard P. Ayres, Cleveland Trust Company; Miss Beatrice Carr, Robinson & Company; Dr. Edmund E. Day, Harvard University; Dr. Charles Gerstenberg, New York University; Mr. Frederick Hoffman, Prudential Life Insurance Company; Dr. Horace Secrist, Northwestern University; Miss Bessie Stern, Maryland State Department of Education, for their assistance in giving valuable information and also for reading the manuscript and giving us constructive criticisms; to Mr. Willard C. Brinton, Consulting Engineer; Dr. Robert E. Chaddock, Columbia University; Dr. John Cummings, Federal Board for Vocational Education; Dr. E. A. Goldenweiser, Federal Reserve Board; Dr. George Havenner, U. S. Bureau of Efficiency; Dr. Lewis Meriam, Institute for Government Research; Miss Edith Miller, National Bank of Commerce; Mr. Charles Coolidge Parlin, Curtis Publishing Company; Mr. M. C. Rorty, American Telephone and Telegraph Company; Mr. W. S. Tower, Consolidated Steel Corporation, for helpful information not otherwise available, and to the officers in a number of important Government departments whose explanations revealed a wealth of information relating to the work of the Federal Government along these lines. It is needless to state that the study itself would have been impossible without the interested co-operation of the 170 or more men and women who responded to our questionnaires and who gave generously of their time for interviews. The initial work on the study was done by Maud Bryan Foote, to whom the Bureau is indebted for many valuable contacts. The study in its present form is largely the work of Beatrice Doerschuk, Assistant Director of the Bureau.

If this report serves to call to statistical work able young women bent on valuable, constructive work, or if it draws the attention of teachers and advisers, and of capable young women lost in the routine phases of it, to the possibilities of professional service along this line, the effort expended by the staff of the Bureau in gathering, compiling, analyzing and reporting the facts set forth will have been justified.

EMMA P. HIRTH.

## PART I.

### The Nature and Use of Statistics

**T**HAT statistics are numerical statements is generally recognized; not all numerical statements, however, are statistics. Statistics are distinguished, *first*, as being numerical statements of facts concerning *groups or aggregates* of persons, things, events or characteristics; *second*, as expressing facts which have been scientifically collected, analyzed and arranged for purposes of *comparison*, for inference, explanation, measurement of progress, organization of plans for future action.

"They are characterized by the effort to penetrate into the multitudinous phenomena of political and social life, of nature and civilization, by the enumeration of characteristic facts, by classification and explanation.

"Among these characteristic facts are those relating to topography, to the population, and its classes in regard to social rank, age, religion, and occupation; to births, marriages, and deaths; to the state and its administration, its martial force, its property, its expenditure and receipts; to the territory in its physical aspects, its elevation, water supply, climate and fertility; to the agricultural, industrial and commercial pursuits of the people, also to their resources and capital; and finally to their strength, their riches, their morality, their public-spiritedness, their social and religious culture, and to their enjoyment of life in its outward manifestations. All of these facts are to be ascertained in reference to actual status and to changes in the course of time."<sup>1</sup>

The significance of facts and their use as a basis in deciding practical methods of procedure are more and more recognized in many different fields of work. Facts, accurately assembled and clearly presented, rather than intuition or custom are rapidly becoming the basis for industrial, commercial and educational, as well as political and social policies. At the seventy-fifth anniversary of the organization of the American Statistical Association in 1914 the president could claim that "the life of the Association

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<sup>1</sup> August Meitzen, *History, Theory and Technique of Statistics*. Translated by Roland P. Falkner. American Academy of Political and Social Science, 1891.



covers the development of statistics into an exact science, its application to all fields of human activity, its utilization as the standard for the measurement of human progress, and its acceptance as the test of the trend and the tendencies of that progress."<sup>1</sup>

Dr. Meitzen has compiled the history and literature of statistics.<sup>2</sup> Statistical records may be considered as dating back to the earliest state enumerations, like the registration of all heads of families in Egypt in c. 600; the counting of the population in Judea, estimated at 100,000 in 1500 B. C.; the description of the provinces in China c. 2300.

In 309 a census of Athens showed a population of 21,000 citizens, 10,000 alien residents and 400,000 slaves. From the middle ages are preserved land registers of different countries, like the Domesday book of William I, 1088, and the inventory of Emperor Frederick II of the crown estates in Sicily, 1241.

Among early official inquiries in which material was collected and treated statistically were seventy-five questions of Philip II directed in 1575 to the prelates of Spain concerning their districts; the answers were classified for the king's use. In 1597-1610 Sully presented to Henry IV his famous reports on the state of the finances and the army. Frederick II of Prussia enlarged the scope of the population census to include reports of trade (beginning with 1747, seventy to one hundred different wares were recorded), an enumeration of factories, seeds and harvests, and ships.

From our own colonial days there is data on the population for Virginia in 1607, South Carolina in 1700, and North Carolina in 1710. In all the British possessions in North America 1,083,000 persons were enumerated in 1753. The Constitution of the United States provided in 1787 for our present decennial census.

The term statistics takes its origin from *state*, and was first used in the middle of the eighteenth century when statistics was the one complete science of the state. Gradually more critical methods were introduced. In 1741 tables, and in 1782 graphical modes of presentation made their first appearance. Numerous methods of observation enlarged the idea of the range of subjects and ideas to be included. Attention was turned from mere descriptions of a general character toward an endeavor to establish causal

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<sup>1</sup>S. N. D. North, in *The History of Statistics*, 1918.

<sup>2</sup>August Meitzen, *History, Theory and Technique of Statistics*. Translated by Roland P. Falkner: American Academy of Political and Social Science, 1891.

relations; figures became the means of measurement and proof. Statistics entered upon its development of scientific method.

Meantime what had been the one complete science of the state was broken up in the rise of political economy, public and administrative law, geography and, in recent times, sociology. Statistics is important to each of these, and has besides grown important in many other than state uses; moreover, its importance has come about largely because of the development of statistics as a distinct method of investigation, so that there have long been two opposing positions in regard to statistics.

One group of statisticians regards statistics as a science with its own subject matter; a portion of human knowledge; the original and perhaps ultimate social science. The statistics which have been built up year after year on those of the past make a mass of systematized knowledge covering the history of peoples; if science is systematized knowledge, then statistics is a science.

Another group regards statistics as a science of *method*, whereby the limits of human knowledge are extended; quantitative logic applicable ultimately in all fields of human knowledge; a scientific procedure, based upon definite principles, for "obtaining judgments and conclusions as to the relations of a mass of changeable and variable things, by an enumeration of characteristic qualities . . . the method of judging collective phenomena from the results of enumerations."

Statistics rests upon the fundamental fact of variation in all nature: no single phenomenon ever repeats itself exactly. It is necessary to analyze sufficiently large aggregates in order to determine averages, variations from the average, and general relations and trends. In the natural sciences statistical methods are largely used; yet original observations in science can be more exact, variations are more minute and relations of cause and effect more definite than in the study of economic and social phenomena; therefore more accurate and more highly refined mathematical formulæ can be applied. In social and economic matters, however, there is much greater complexity with seldom a high degree of accuracy but rather a wide margin of error, and too highly refined formulæ may not be applied.

Practically, then, statistical method is still commonly understood to apply to economic and social facts and the statistician to be concerned with economic and social phenomena, while the more refined methods applied in the natural sciences and engineering are rather pure mathematics. Such an understanding is assumed in the present study. In this generalization psychology and education

are included among the social sciences, and biology, in which statistical method has been a most important tool, is on the border line: yet, however expert a statistician the psychologist may be, he is pre-eminently known as a psychologist; and although the biologist may make important contributions to statistical methods, he continues to be known as a biologist, while the term statistician is usually reserved for those concerned with economic and social group facts.

Titles are, however, not defined: the economist must know something of statistics and may be primarily a statistician; the statistician may be termed trade adviser or research worker; and while real statisticians are reluctant to assume the title, it is often loosely applied to anyone engaged in statistical work.

A few examples may be cited to illustrate the present diversity and use of statistics.

Prices of commodities are recorded and analyzed in determining the cost of living and its fluctuations.<sup>1</sup> Prices are compared and averaged with such other business facts as bank clearings, stock prices and trading, building permits, imports, business failures, bank loans, discounts, investments and deposits, dividend payments, in a survey and forecast of business conditions.<sup>2</sup>

The prices of raw material used in the manufacture of paper—rags, wood pulp, paper scrap, chemicals, and supplies were compared over a period of years, organized into a price index, compared with other price indices, and the results considered in relation to various business facts in order to estimate intelligently the situation in the paper industry, to lay future plans, and to advise printers and merchants.<sup>3</sup>

The production, consumption, imports and exports of dairy products, the food values of milk and the uses to which milk is put were statistically studied as a basis for recommendations in regard to the dairy industry in the United States.<sup>4</sup>

The facts concerning the manufacture of commodities in the United States and abroad are collected and analyzed in order to find an intelligent basis for a tariff policy.<sup>5</sup>

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<sup>1</sup>U. S. Department of Labor, Bureau of Labor Statistics, *Monthly Review*.

<sup>2</sup>Harvard University Committee on Economic Research, *The Review of Economic Statistics*.

<sup>3</sup>American Writing Paper Company, *Index Number of Paper Production Costs*, 1920.

<sup>4</sup>U. S. Department of Agriculture, *The Agricultural Situation for 1918, Part II, Dairying*.

<sup>5</sup>Reports of U. S. Tariff Commission.

Wage records have been compared with the cost of living and the financial condition of the occupation in determining a minimum wage for the occupation;<sup>1</sup> standard wages have been compared with compensations received with resulting conclusions which formed the basis of a plea to state legislatures for considering more adequate accident compensation rates.<sup>2</sup>

Employment reports have been analyzed and compared in attempts to solve the unemployment problem;<sup>3</sup> or to shed light upon the conditions and instability of child labor.<sup>4</sup> The collected facts concerning disability days for a certain group of workers led to inferences as to the influence of age as a factor in disability and the variation in amount of disability in different occupations.<sup>5</sup>

School records have been analyzed to determine the increase in the cost of education, teachers' salaries were compared with the cost of living and with salaries of other workers, sources of school income were compared—all in order to point the way to the future needs and financing of education.<sup>6</sup>

The records of individual prisoners including such items as the nature and extent of delinquency, age, civil condition, nativity and color, factors in early home conditions, educational background, occupational history and efficiency, mental capacity have been studied in order to infer principles for the actual treatment of the case within the institution and to point out causes of delinquency.<sup>7</sup>

A beginning has been made in applying quantitative measurement of characteristics in the judgment of the fitness of men and women, for college entrance or for vocations, for instance, and we may look forward to a time when "sufficient insight and investigation should enable us to secure all the advantages of the impressionistic judgment (except its speed and convenience) without any of its defects."<sup>8</sup>

"Statistical science has brought to biology three fundamentally important things which it had previously lacked. These are: first,

<sup>1</sup> Department of Labor and Industries of Massachusetts, Minimum Wage Division, Paper Box Occupation Decree No. 17, et al.

<sup>2</sup> Ethelbert Stewart, in *Monthly Labor Review*, December, 1920.

<sup>3</sup> Statistics of Unemployment and the Work of Employment Offices in the United States, U. S. Department of Labor, Bureau of Labor Statistics, Bulletin No. 109.

<sup>4</sup> Industrial Instability of Child Workers, U. S. Department of Labor, Children's Bureau, Bulletin No. 74.

<sup>5</sup> George Rubin, *Statistical Review of Disability in the Workmen's Circle*; *Modern Medicine*, November, 1920.

<sup>6</sup> W. Randolph Burgess, *Trends of School Costs*, 1920.

<sup>7</sup> Dr. Mabel Fernald and others, *A Study on Women Delinquents in New York State*, 1920.

<sup>8</sup> Edward L. Thorndike, *Fundamental Theorems in Judging Men*, in the *Journal of Applied Psychology*, March, 1918.

a method of describing a *group* of individuals in terms, not of its component individuals, but in terms of its (the group's) own attributes and qualities; second, the concept of 'probable error' which makes possible an estimate of the probable accuracy of a series of observations; and third, a method of measuring the degree of association or correlation between the variations in a series of characters or events."<sup>1</sup>

In summary, some definitions are quoted to amplify further the conception of statistics:

"Statistics may be defined as numerical statements of facts by means of which large aggregates are analyzed, the relations of individual units to their groups are ascertained, comparisons are made between groups, and continuous records are maintained for comparative purposes. From this definition it is to be noted that statistics represent *facts* stated numerically; secondly, statistics deal with aggregates or masses which are sufficiently large to reveal types or standards even if individual units show wide variation. This tendency for large aggregates or groups to conform to definite types or standards or to show general or underlying tendencies is what is meant by the 'law of averages.' Statistics finally are used chiefly for purposes of comparison. Individual units or classes are compared with the entire group of which they are a part; different groups are compared; and comparisons are made for a single group at different periods of time in order to reveal tendencies."<sup>2</sup>

"Statistics are numerical statements of facts in any department of inquiry, placed in relation to each other; statistical methods are devices for abbreviating and classifying the statements and making clear the relations. The elementary methods are based on arithmetical processes of an easy but specialized kind; more refined methods, necessary for certain classes of investigation, involve complex mathematical ideas."<sup>3</sup>

"When we are investigating the nature and causes of things and events in the natural and social sciences, we are face to face with *facts*. In statistics about these events we are brought face to face with syntheses. The statistician must regard his figures as a sort of symbol, whose character and significance are more or less enigmatic; and he must diligently seek out all the probable causes

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<sup>1</sup> Raymond Pearl, The Service and Importance of Statistics to Biology, in the Quarterly Publication of the American Statistical Association, March, 1914.

<sup>2</sup> Melvin T. Copeland, Business Statistics, 1917.

<sup>3</sup> Arthur L. Bowley, An Elementary Manual of Statistics, 1915.

of the facts he has symbolized before him, with a view to their scientific explanation.”<sup>1</sup>

“We shall use the term statistics as meaning aggregates of facts ‘affected to a marked extent by a multiplicity of causes,’ numerically stated, enumerated, or estimated according to reasonable standards of accuracy, collected in a systematic manner for a predetermined purpose, and placed in relation to each other.

“This definition seeks to emphasize the fact that before numerical data can be termed ‘statistics’ they must bear evidence of having been collected in accordance with at least the rudiments of scientific method and for a definite purpose. It is necessary to insist that these conditions be fulfilled in order to know anything about the units of measurements employed and the scope and representativeness of the facts given numerical expression. Data not fulfilling these conditions may be numerical but they are not statistical.”<sup>2</sup>

“Theoretical statistics is the doctrine of a strictly systematic process of investigation which can be properly applied to every concrete object conceived as complex and changeable. Statistics is capable of furnishing knowledge attainable in no other way as to the connections and relations of things in this changing aggregate. This doctrine constitutes a well ordered system of ideas, demands, and principles which have definite relations to the general theory of perception. . . .”<sup>3</sup>

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<sup>1</sup> P. Coffey, *The Science of Logic*, Vol. II.

<sup>2</sup> Horace Secrist, *An Introduction to Statistical Methods*, 1917.

<sup>3</sup> August Meitzen, *History, Theory and Technique of Statistics*, Translated by Roland P. Falkner: American Academy of Political and Social Science, 1891.

## PART II.

### Statistical Method

**I**N spite of divergent views among statisticians as to the scientific position of statistics, there is entire agreement as to the demands and conditions of statistical method. In suggesting the character of this method there are certain distinct processes to be observed.

(1) A plan must be organized for the study of the problem in hand. The end in view and the resources which can be drawn upon will indicate in which manner and within which limits the inquiry will be made and the answer given. The plan must include the formulation of the scheme of tabulation, and the formulation of the schedule which shall secure precisely the data desired for the tabulation.

"Similar problems confront the corporation, organization, or department preparing blanks for keeping records of their activity, and the persons responsible for the planning of an investigation or for the taking of a census. Briefly stated, it is to obtain the maximum of reliable information with the minimum number of questions."<sup>1</sup>

(2) The facts must be gathered in such a way as to insure their accuracy and adequacy. There are definite principles governing the collecting of statistical data. The group measured must be large enough and representative enough to be typical for the purposes in mind; nothing can bring statistics into disrepute so readily as the promulgation of conclusions based upon data too scant to be representative.

Units of measurement must be accurately determined; this determination requires a careful study of the whole problem in all its aspects and is involved in making the plan for the study.

In assembling data concerning *wages* it has been pointed out, for example, that

"A number of distinctions must be made in order to use the term in statistical studies. Wage-rates must be distinguished from

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<sup>1</sup> W. B. Bailey, John Cummings, *Statistics*, 1917.

earnings; nominal rates from real rates; and earnings from labor (wages) from earnings from all sources including returns from investments, rents, etc. It is necessary also to distinguish wage-rates from salary-rates, and wages (wage-rates times the period for which paid) from salaries (salary-rates times the period for which paid). In converting wage-rates into wages the former must be increased by the money equivalent of concessions and perquisites and decreased by the money equivalent of time lost for which no compensation is received. Money wages must clearly be differentiated from real wages, or the purchasing power of nominal wages measured by a constant standard. When computing real wages and making allowance for concessions, perquisites, payments in kind, and unemployment, the nominal money equivalent must be reduced to its purchasing power and added to or subtracted from, as the case demands, the money wages similarly reduced.”<sup>1</sup>

(3) Schedules must usually be examined and formally edited for consistency, uniformity and completeness before the data is tabulated.

(4) Tabulation is the compiling process. The scheme of tabulation involves many perplexities; comparability of the data with corresponding data in similar inquiries should be preserved even at some sacrifice of improvement of classification; there may not be so many mechanical distinctions as to obscure rather than clarify the significance of the data and yet important distinctions must not be ignored; the significance of the data must be fairly represented but any significance not inherent in the data avoided.

(5) Ratios, averages, index numbers and coefficients of correlation are derived from the numbers obtained by tabulation of data and are used for purposes of analysis and interpretation of statistics. Ratios express relations: total population figures have meaning only in relation to other figures of population at different times or in different countries; or when analyzed into the proportion of foreign-born to native population, or percentage distribution by age, sex, or race, or relation of population to area, or wealth per capita, or proportion of death, birth and marriage rates, etc.

In statistics averages are the generalizations. The process of averaging eliminates the particular differences in the quantities averaged. When these particular differences are insignificant the average is a very convenient figure; when the differences are im-

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<sup>1</sup> Horace Secrist, *An Introduction to Statistical Methods*, 1917.



portant the average may be very misleading. The arithmetic average, the geometric mean, the median (the middle term among items which have been arranged in a series in order of magnitude), the mode (the number which is most frequent in a series) are all used in statistics and the peculiar merits of each must be understood in their use. Variations from the average may be shown numerically or by graphs and are variously calculated.

"The index number is a well established statistical device commonly used for measuring changes in wholesale and retail prices and rates of wages over long periods of time. Such a number may be constructed by securing each month the prices of a uniform list of commodities at a selected and unchanging list of establishments, and then computing the average price for the whole list for each month. As this average rises or falls, it reflects the general changes taking place in the prices of the types of commodities represented. If some of the commodities are more important than others, or are commonly consumed in greater quantities, methods of weighting are used to make sure that each element shall exercise only its proper share of influence in the final result."<sup>1</sup>

Definite mathematical formulæ have been developed for determining the coefficient of correlation.

"When two quantities are so related that the fluctuations in one are in sympathy with fluctuations in the other so that an increase or decrease of one is found in connection with an increase or decrease (or inversely) of the other, and the greater the magnitude of the changes in the one, the greater the magnitude of the changes in the other, the quantities are said to be correlated."<sup>2</sup>

"Social phenomena are universally correlated, interrelated and mutually reactionary, and although this universal correlation cannot be established or proved statistically, it is, nevertheless, a working hypothesis upon which statistical inquiry proceeds. It follows that every social phenomenon is, on the one hand, an effect, and on the other a cause, of other phenomena of equal social value. A complete analysis separating out all the influences acting and reacting in any social tendency is impossible and frequently it is exceedingly difficult to isolate even the immediate principal influences. . . . While it is generally true of social phenomena that they cannot be completely analyzed, unless in any given case some relationship or correlation is established one primary purpose of statistical inquiry has not been achieved. So long as the social tendency remains

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<sup>1</sup> Leonard P. Ayres, *An Index Number for State School Systems*, 1920.

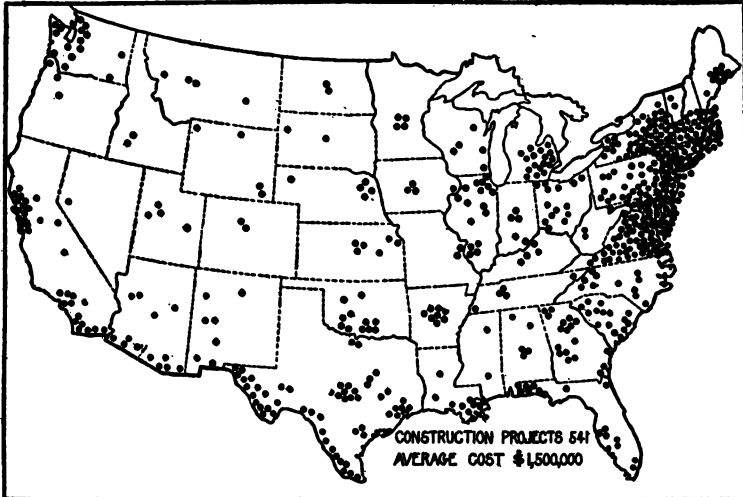
<sup>2</sup> Arthur L. Bowley, *Elements of Statistics*, 1915.

uncorrelated, it is an isolated phenomenon which cannot be intelligently comprehended. It constitutes an unsolved statistical problem.”<sup>1</sup>

“When we vary the cause the phenomenon changes, but not always to the same extent; it changes, but has variation in its change. The less the variation in that change, the more nearly the cause defines the phenomenon, the more closely we assert the association or the correlation to be. It is this conception of correlation between two occurrences embracing all relationships from absolute independence to complete dependence, which is the wider category by which we have to replace the old idea of causation. Everything in the universe occurs but once, there is no complete sameness of repetition. Individual phenomena can only be classified, and our problem turns on how far a group or class of like, but not absolutely same, things which we term ‘causes’ will be accompanied or followed by another group or class of like, but not absolutely same things which we term ‘effects’.”<sup>2</sup>

**Illustration 1**—A statistical map (or cartogram) in which Points are used to indicate distribution.

(Reprinted from *The War With Germany*, with the permission of Dr. Leonard P. Ayres)



Construction projects of the Army in the United States

<sup>1</sup> W. B. Bailey, John Cummings, *Statistics*, 1917.

<sup>2</sup> Karl Pearson, *The Grammar of Science*, 1900.

**Illustration 2—A diagram (or chart or pictogram) showing the use of Bars.**  
*(Reprinted with the permission of the War Trade Board)*

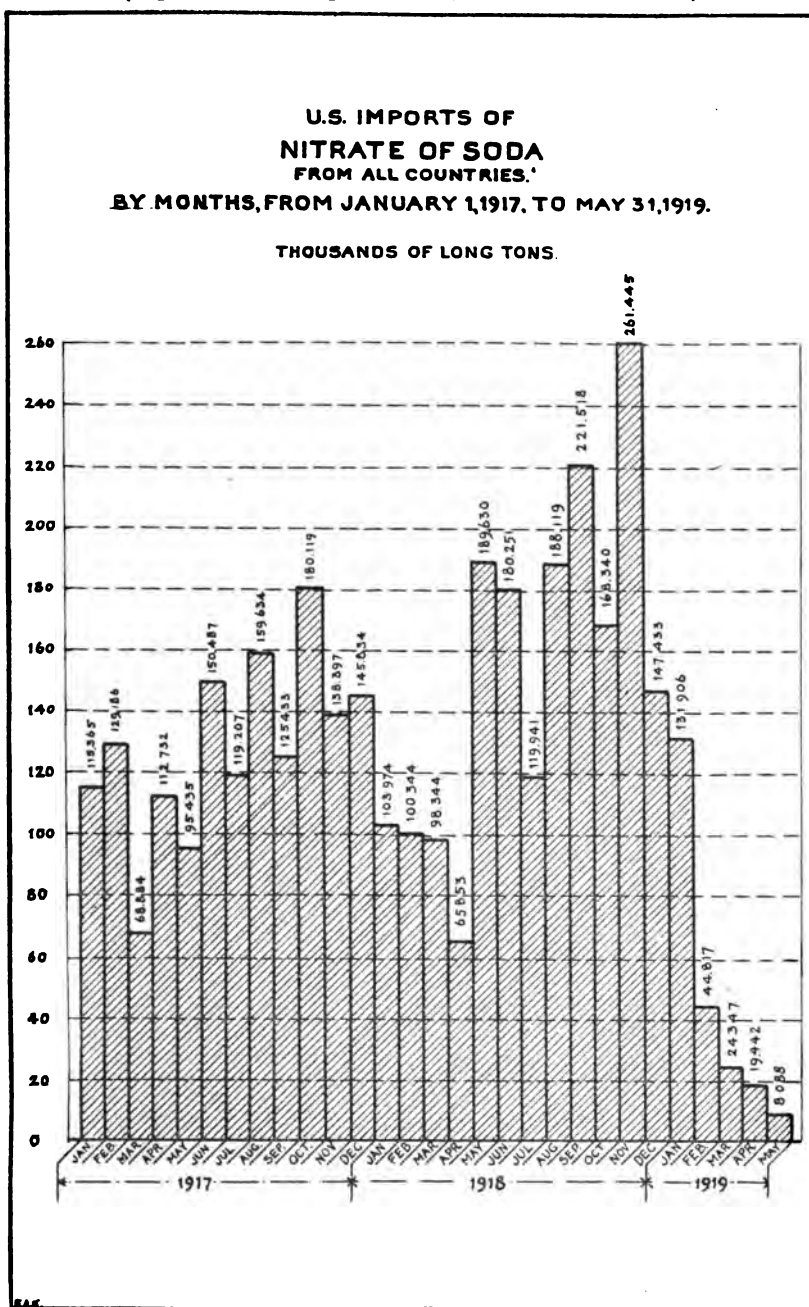
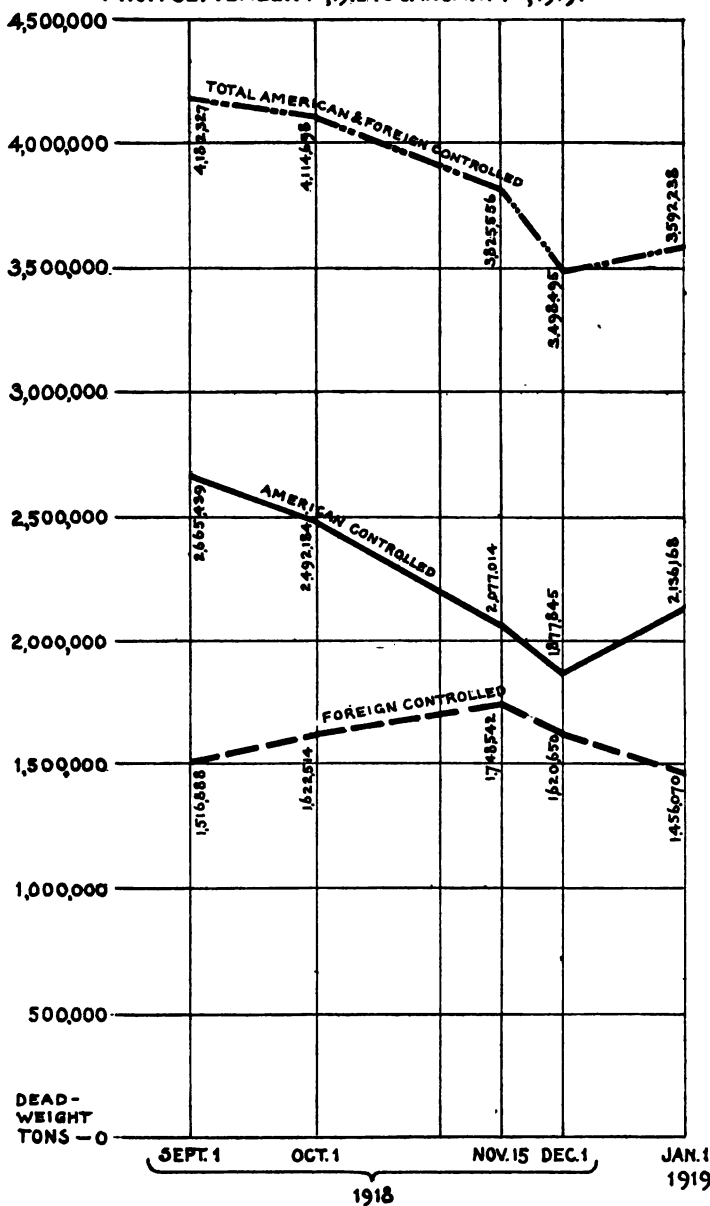


Illustration 3—A diagram (or chart or graph) showing the use of the Statistical Curve.

(Reprinted with the permission of the War Trade Board)

# **TOTAL TONNAGE OPERATING INTRADE WITH CENTRAL AMERICA, SOUTH AMERICA AND THE FAR EAST.**

FROM SEPTEMBER 1<sup>ST</sup>, 1918 TO JANUARY 1<sup>ST</sup>, 1919.



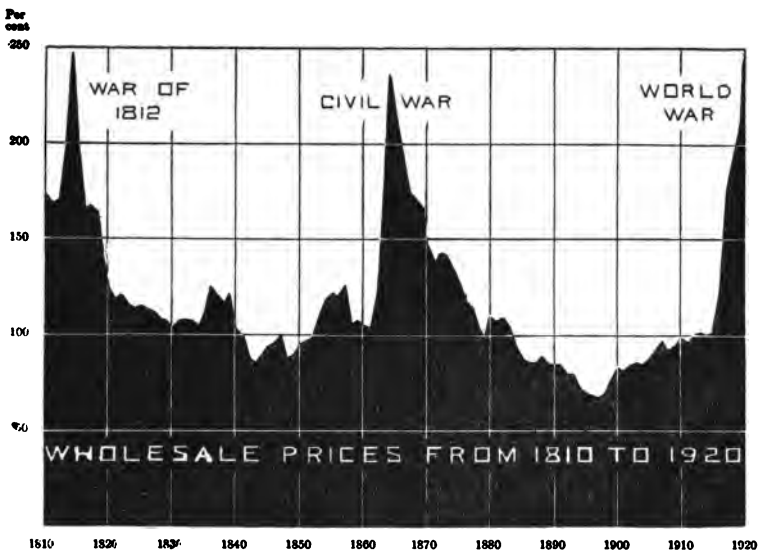
(6) Results must be arranged for presentation in convenient form in tables or through illustrations which may be more readily grasped. Tables may contain all of the details classified according to their most numerous common characteristics or they may contain data arranged in such summarized form as to center the attention upon some distinctive characteristics or relationship which they suggest.

Statistical illustrations are graphical or diagrammatic representations of the same facts included in tables; the meaning of the facts is thrown into relief and enhanced; sequences, proportional relations between facts, distribution, etc., can be read at a glance. Graphs are also significant as an aid in computation.

The various forms of graphic representation are sometimes all called graphs, sometimes all diagrams. They have been grouped into graphs and diagrams, graphs indicating statistical curves and diagrams including "pictograms" (using lines or bars, surfaces, and volumes) and "cartograms" (maps). They have also been simply classified according as points, lines or bars, curves, areas

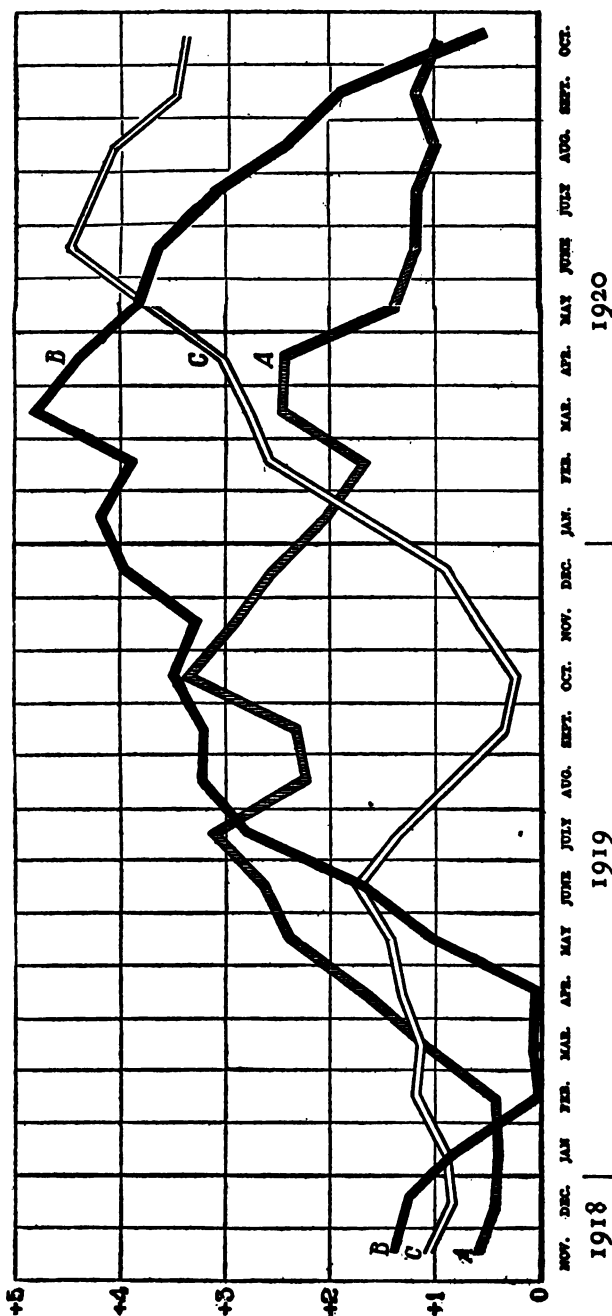
**Illustration 4—A striking presentation of a statistical Curve.**

(Reprinted from *Price Changes and Business Prospects*, with the permission of Dr. Leonard P. Ayres)



Wholesale prices in the United States for 110 years.  
Prices in 1914 = 100

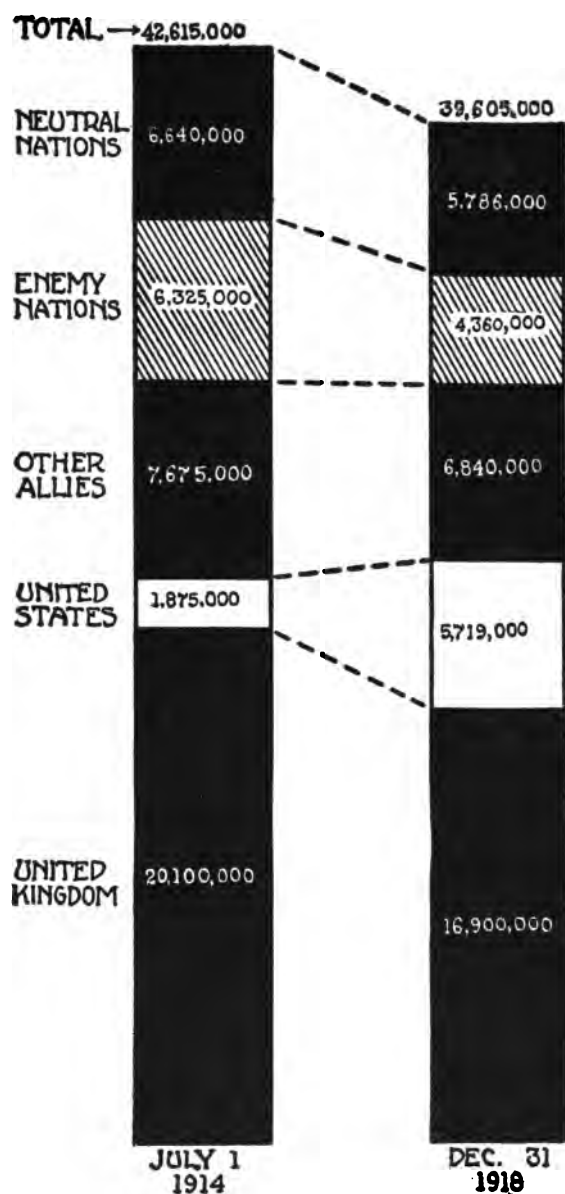
Illustration 5—Statistical Curves presenting an index of business conditions.  
 (Reprinted with the permission of the Harvard University Committee on Economic Research)



GROUP A — SPECULATION: New York Bank Clearings, Shares Traded on the New York Stock Exchange, Price of Industrial Stocks.  
 GROUP B — BUSINESS: Bank Clearings Outside New York City, Bradstreet's Price Indices.  
 GROUP C — BANKING: Rate on 4-6 Months Commercial Paper, Rate on 60-90 Day Commercial Paper.

**Illustration 6**—A diagram (or chart or pictogram) showing the use of Surfaces.

(Reprinted from *The War With Germany*, with the permission of Dr. Leonard P. Ayres)



Seagoing merchant shipping of the world measured in gross tons on July 1, 1914, and December 31, 1918.

or maps are employed. The illustrations on these pages have been chosen to show the use of these various devices.

*Points* are effective in illustrating distribution or comparative density; they are difficult to interpret in numerical terms.

*Line or bar* diagrams are commonly used in great variety; any number may be represented graphically by a line drawn to scale, so that the length of the line is determined by the number represented; lines are widened into bars only to make them more readily distinguishable.

*Curves or graphs* are a very important means of presentation of the distribution of facts at one stated time and the sequence of facts over a period of time. They have the advantage over bar diagrams of being uninterrupted. Two dimensions are used; the scale is planned according to the range represented by both measurements. A series of points corresponding to the classified data in hand is located on this scale and the points are joined by a line; this broken straight line may be smoothed into a true curve in accordance with certain accepted principles. Several different facts may be shown in one chart. In some cases paper with logarithmic ruling in one or both directions is used; a percentage plotting paper has also been devised for use in certain instances.

Series of numbers may be represented by series of figures illustrating comparative *areas*; rectangles, triangles, circles and various other surfaces are so employed. Small figures may be drawn within larger ones, circles may be segmented into a "pie-chart"; rectangles may be built into pyramids—endless variety is possible. "Stereo-grams" or solids may represent three variables but are more complicated and less frequently used.

*Maps* are most commonly shaded by a variety of cross-hatching according to the magnitude or frequency of the facts represented. They may also be dotted to indicate distribution and frequently they are done in various colors. From maps comparisons may be made respecting position as well as magnitude and frequency.

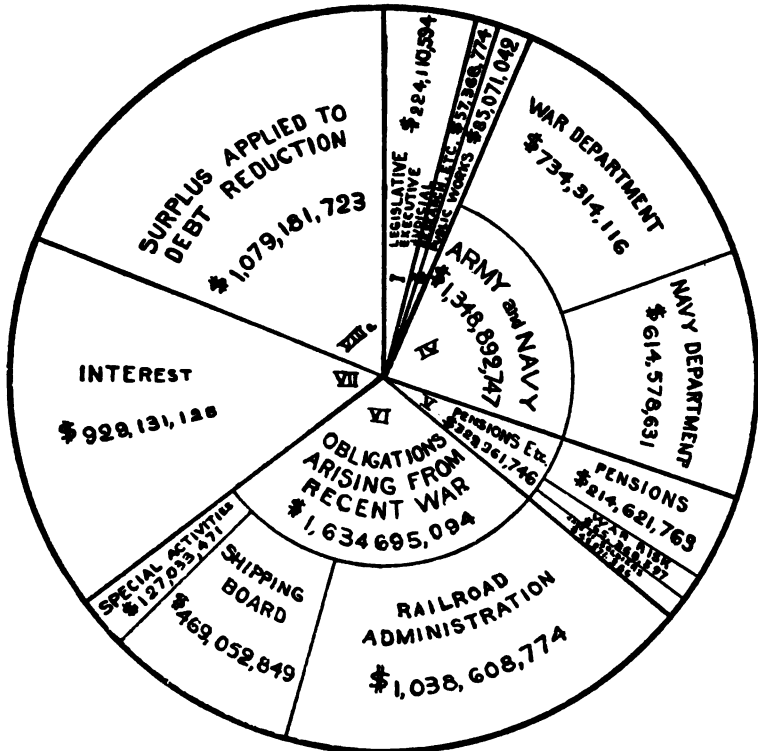
When graphs are used as an aid to computation every other feature is sacrificed to the accuracy and convenience of mathematical results.

"When charts and diagrams are prepared for the trained executive, and at his invitation, it is reasonable that he should make some effort to learn the language in which they can speak most fluently and effectively. But when the chart or diagram sets forth, uninvited, to make its appeal to the casual or untrained reader, it



**Illustration 7**—A second diagram showing the use of Surfaces—a "Pie-Chart."

(Prepared by Edward B. Rosa, U. S. Bureau of Standards, and reprinted with the permission of the American Academy of Political and Social Science)



### TOTAL NET EXPENDITURES - 1920

**\$5,687,712,848**

(NOT INCLUDING LOANS AND TRUST FUNDS)

The figure represents the total net expense of the United States Government for 1920, and in addition, the sum of \$1,079,181,723,—which is the surplus of total net tax revenue or total net expenses,—applied to the reduction of the Public Debt. This item is included with the current expense items shown in the figure in order to show the disposition of the entire amount collected by taxation.

The percentage distribution of the expenditures is as follows:

Primary Governmental Functions.....	3.9%
Research, Education, Development.....	1.0
Public Works—New Construction.....	1.5
Army and Navy.....	23.7
Pensions (5.8), Interest (16.3), Debt Reduction (19.1), and Recent War Obligations (28.7).....	69.9

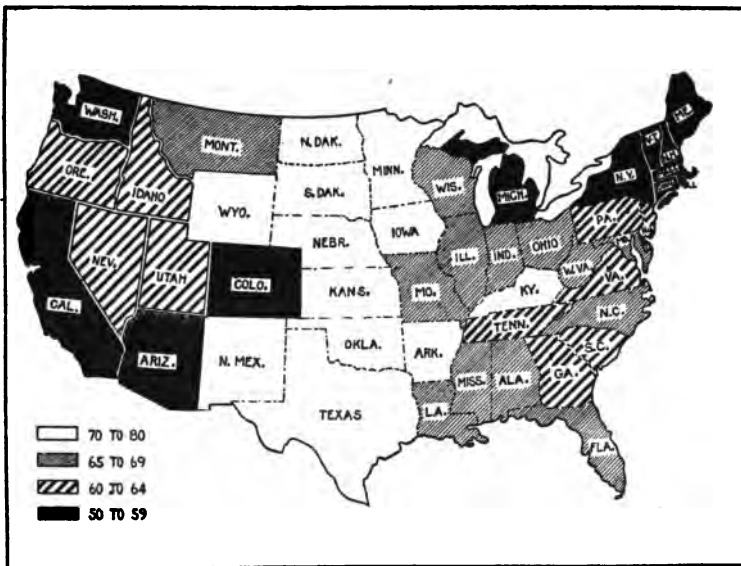
Total ..... 100%

must speak in the language of its auditors. Popularized graphics must, therefore, take on as many forms as there are types of audiences to which they may be addressed. . . .

"No system of charts and diagrams can be better than the facts and analyses upon which it is based. Up to a certain point, a clever use of graphics will illuminate and make significant even the crudest system of records; but the possibilities in this direction will soon be exhausted if the fundamental accounts and statistics are in themselves inadequate.

**Illustration 8**—A statistical Map (or cartogram) showing the use of cross-hatching.

(Reprinted from *The War With Germany*, with the permission of Dr. Leonard P. Ayres)



Per cent of drafted men passing physical examination, by States

"On the other hand, the complexities and magnitudes of many modern business and industrial operations are so great that even the most thoroughly trained executive backed up by the best system of records and accounts, will be aided very greatly in carrying the load of administration if masses of figures are made easy of comprehension by reduction to graphical form."<sup>1</sup>

<sup>1</sup> M. C. Rorty, *Making Statistics Talk*, in *Industrial Management*, December, 1920, January, 1921.

There are definite limitations to the proper use of graphic forms of representation. To guard against the careless and misleading use of them a joint committee representing several engineering and statistical societies has been studying the problem of standardization of graphic presentation.<sup>1</sup>

(7) The purpose of statistical method is attained in the comparison and interpretation of the facts gathered, classified and combined into aggregates—the synthesis, the conclusions drawn from the premises offered by properly collected and analyzed data. This is evidently the crux of the whole matter—the procedure from the descriptive material to a judgment of quantity, causality, or future probability. It requires the scientific spirit to hold a purpose in mind, to suspend judgment until satisfactory facts are at hand, and to interpret such facts without bias. Statistics do not answer questions nor support conclusions independently of those who manipulate them. Judgment, candor and integrity in their use are necessary at every step.

The writing of reports is an important concluding process. Results must be expressed with clearness.

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<sup>1</sup>Joint Committee on Standards for Graphic Presentation. Preliminary Report in the Quarterly Publication of the American Statistical Association, December, 1915.

### PART III.

## Kinds of Positions in Statistical Work

**S**TATISTICAL WORK involves the services of many persons who carry out subsidiary tasks and of comparatively few persons who bear the main responsibility—plan the work, do the thinking and draw the conclusions. Positions and terms have not become standardized. There are so-called “statisticians” who have no technical knowledge of the subject in reference to which the statistics are compiled, whose work requires practical skill rather than scientific understanding; there are, on the other hand, “clerks” who have acquired considerable technical knowledge and who carry a large measure of responsibility. The general distinction between the subordinate and the responsible, directive work must be kept steadily in mind. Dr. Lewis Meriam discusses this distinction as follows:

“The clerk must know that a fact is, or that a certain thing is done. The scientist must know the philosophy that underlies the fact and the reason that underlies the procedure. It is enough for one of our statistical clerks to know that a given country lies in a given Trade Region. Our geographer must be able to tell us why it is placed in that Trade Region rather than in the one to the south or to the north. The clerk knows where the Trade Region boundaries run, the scientist knows why they run that way. The clerk knows that certain commodities are consolidated for a given tabulation and then converted. The commodity expert knows why figures for vegetable oils as a group are more useful than those for each oil separately. These are illustrations from our Shipping Board experience. Others can be found almost anywhere. Some people call what I have termed a clerical knowledge a working knowledge or a practical knowledge. The scientific knowledge is a practical as well as a theoretical.”

For the person of broad general education and training in statistical technique various forms of subordinate work offer the opportunity for apprenticeship and preparation for professional work. For others the subsidiary positions in themselves offer differentiated opportunity for useful and satisfying work.

Since statistical work as a vocation is still in a formative stage, and since the general demand for people to do such work is recent, definitions of positions are lacking and lines of promotion are indefinite. The following classification is based upon the terms used by statistical workers who have reported for this study, and the work included under each.

### SUBSIDIARY WORK

*Statistical Machine Operator.* There are various wonderful machines for computing, assorting, card punching and tabulating which are used in the classification of data. The manager of the auditor's department of a large railroad reports that his "chief statistician is a machine." When "statistics" consist of repeated reports on similar subjects this is possible. Machines multiply, divide and give totals; punch, mark and give results in code, verified also by machine. Finally the Hollerith or the Powers machine, distinct from the computing machines and ordinarily handled by a different staff, tabulates the full result in figures after the code cards have been distributed to the right section by sorting machines. The use of the machines is taught in the office. Their operation requires a certain technique and skill but in itself is routine work.

It is often combined with clerical work of varying degrees of responsibility—the verification of the classification; filing of cards; symbolizing schedules, questionnaires, reports and other documents according to a code to be used in punching, which requires that the worker carry codes and classifications in mind and acquire and apply a thorough clerical knowledge of the subject matter involved.

Computing and tabulating machines are used in a large variety of organizations in which records must be kept, as well as in statistical departments and the subject matter of the records differs widely. For example: an operator of tabulating machines who works for a board of public education handles teachers' and children's health reports, school census reports, and reports on expenditure of labor and material in the schools. In the manufactures division of the Census Bureau a machine operator may be tabulating census returns of industries according to states, kinds of products manufactured, quantity of products, rank by value of products, or the distribution of workers engaged in manufactures. All this information may be indicated by code on one card and the machine be adjusted to secure the desired summaries.

An experienced operator may become supervisor of a division of statistical machines.

*Computer.* A computer applies to collected facts the necessary mathematical operations for analysis and development of significant derived figures; to insure absolute accuracy all work must be verified; statistical machines may or may not be used. The computer needs to know the subjects to which the statistics relate well enough to understand what results are desired.

A computer in an insurance company, for example, may figure ratios by means of the millionaire machine and slide rule, find averages, find differentials and arrange tables on a uniform base for purposes of comparison; or she may keep records of all policies in force, which are changed from month to month, figure all policy values, new rates, reinsurance, and the valuation of the policies at the end of the year for the annual statements. In shipping, a computer figures tonnage, converts the various customary units of all commodities to long tons, figures percentages, insurance tables, etc.

A computer may become office supervisor or assistant to the chief of the computing section, or chief of the computing section. An assistant to the chief of a computing section describes her work as including principally verification of statistical data for which it is necessary to understand the ultimate aim and use of the data, some compiling and computing, and supervision in the absence of the chief.

The chief or head of a computing section receives all orders for computing jobs and plans and verifies the work; in a smaller organization she may also collect data and do preliminary drafting.

*Statistical Draftsman.* The work of a statistical draftsman is the arrangement of data in form for interpretation and presentation in diagrams, pictures, models, maps, charts or graphs. Training in mechanical drafting or in the drawing of graphs is required. There is frequently considerable chance for originality and discrimination in planning what form will be most significant for the presentation of various kinds of data. A degree of skill is essential, and some comprehension of the subject matter and the purposes of the statistics is involved.

A statistical draftsman may, for instance, spend days in painstaking cross-hatching of various sections of maps, with different shadings to represent quantities which will indicate comparative amounts of production of cotton or grain; or she may fill in colors on maps to show comparative working hours for women in different states; or she may be chiefly engaged in plotting graphs from statistical data to show the increase in railroad miles per thousand population compared with the increase of bank deposits per capita,

or the fluctuation in wholesale commodity purchasing power of the dollar. It is in the larger statistical departments that a worker is employed for drafting only. Frequently drafting is combined with computing or with other clerical work. Sometimes clerks engaged in related work as, for instance, accounting, are taught to draw graphs.

In large organizations there is a supervisor of the drafting department who administers the work of the department and carries a large share if not all of the responsibility for determining the form in which the material is to be prepared—whether graphs or maps or pie-charts or some other form will best express the comparison to be presented.

### SEMI-PROFESSIONAL WORK

*Statistical Secretary.* There are occasional secretarial positions in which the ability at least to classify data for statistical use is applied, as well as stenographic skill. Such positions have proven good stepping stones into statistical work, where, for instance, a woman has entered an office in a clerical capacity and by her conscientious interest in the organization has found the latent value of material at hand but unorganized, or in cases where a secretary has assisted in statistical clerical work and has developed skill and intelligence in such work of greater value to her employer than stenography.

*Statistical Accountant.* The records with which the accountant works are most important business data reporting the financial status of the business, the financial results of current operations, and variations from normal performance. The statistical accountant must first of all know accountancy; she must also be able to analyze her records for graphic presentation of the current facts, trends and variations indicated by her records, in reports for executives. Particularly does the cost accountant need to be able to tabulate and present graphically as well as analyze cost figures and price data. For example, a graphic chart made up from the records of monthly production of rolled plate in tons and operating cost per ton will show in convenient form for quick comprehension the standard cost of production corresponding to different rates of output in a steel rolling mill.

*Statistical Laboratory Worker.* Where statistics are taught or courses are given involving economic, social, psychological or other

scientific investigation, there may be a laboratory worker who plans exercises, grades papers, oversees the practice work of the students, and supervises the collection and classification of data. This position exists only rarely. It is likely to be a part-time position and therefore desirable for one who wants to devote the remaining time to graduate study.

*Statistical Editor.* This position is seldom found separated from more general statistical work and varies considerably in requirements. One who is employed as statistical editor may be responsible for seeing that statistical reports are put into printable form and order; that there is a clear, logical statement of the material; that statistics and manuscripts are edited for publication and that the process of publication is properly carried out. She must understand both the material and the methods applied to it.

One such editor assists in the preparation for publication of the current business forecast of a statistical organization; another prepares for publication statistics and manuscript on which others have worked and at the same time plans and supervises office activities. In a health research organization a statistical editor receives the various statistical reports sent in from the field and edits them for printing with a clear statement of the material in the reports without comments by the editor. In another instance the statistical editor looks up library sources, writes digests, abstracts and annotations of information found, edits the final material and reads proof.

*Statistical Clerk.* This term covers a considerable variety of duties in different positions and may be applied to any one of the positions already described. The statistical clerk is usually engaged in the different processes of collecting, tabulating and computing the data to be presented. Her work may be quite routine, as, for example, copying figures from documents and reports to tabulations that require little knowledge of the subject matter, computing by hand or by the use of machines.

The position of statistical clerk may, on the other hand, carry with it considerable responsibility and the necessity for acquiring a thorough knowledge of the subjects to which the statistics prepared relate; as, for example, deciding as to the form in which the material is to be presented; assisting in preparing statistical reports for the printer; supervising a division of statistical clerical workers, carrying responsibility for statistical output both as to quantity and accuracy; planning table forms, graphs and working forms and writing titles and explanatory notes.



The broad use of the term may be illustrated by a few instances of the varying work of women who are classified as statistical clerks:

"General statistical work, editing, tabulating, computing."

"Research, compilation, preparation of maps."

"Stenographer and typist with considerable statistical work."

"Receiving and checking schedules and tabulating the information they contain."

"Arranging and planning statistical compilations; responsible for all final checking; charge of the office."

"Copying payroll records; computing totals and averaging weekly earning tables according to occupations, establishments, hours, age, experience, etc.; also making a fluctuation of employment table or curve showing the per cent of women employed during the different months of the year; this brings out seasonality in an industry."

*Field Investigator.* A field investigator is primarily concerned with the collection of data. She is frequently sent out with perfectly definite schedules in hand, charged with securing the data required by the schedules from definitely prescribed sources. This work is largely routine, but requires tact in approaching people from whom information is sought and judgment is discriminating between fact and opinion and in selecting the material pertinent to the purpose in mind. The value of any statistics depends to a large degree upon the accuracy with which the original data are collected.

The work of a field investigator may be more varied and responsible; information is variously obtained, through interviews, questionnaires and letters, from original records, or in the case of secondary data, from related material available in printed form. The investigator in many cases is also responsible for determining sources, planning the forms to be used for gathering data, classifying her material and planning the kinds of tables for its presentation, and for offering her own comparisons and interpretations.

## PROFESSIONAL WORK

*Statistician.* The positions so far described are subsidiary. The statistician is familiar with the content of all of them and maintains contact with all the steps of the processes involved in statistical work. "Without coming in touch with the actual situation occasionally the statistician loses sight of the human element behind all figures. Without tabulating his own schedules, he does not know the weak spots in his schedule and in his information."

The statistician is distinguished, however, by the responsibility for planning, directing and interpreting the results of original statistical investigations. The statistician must have the vision to select, estimate and organize the problems, and the sound judgment and wide knowledge to determine the methods to be employed, to interpret the significance of collected facts without bias, to recognize underlying principles, and to recommend action in accordance with such interpretation. This is the crux of the whole process; it presupposes a broad general background, a fundamental understanding of the subject covered and a comprehensive knowledge of statistical science and methods. The statistician is not only active with immediate problems but is usually contributing also to the further development and application of statistics.

The statistician may be primarily concerned with a special kind of statistical data; there are in current use more or less well defined terms to differentiate the character of such data:

I. *Vital statistics* are "the numerical registration and tabulation of population, marriages, births, diseases and deaths coupled with an analysis of the resulting numerical phenomena."<sup>1</sup>

"Vital statistics are the statistics of life.

*Morbidity statistics* are the statistics of disease.

*Mortality statistics* are the statistics of death.

*Birth, death and migration statistics* relate to population movement. Statistics of births and of immigration show population increment. Statistics of deaths and of emigration show population decrement."<sup>2</sup>

*Demography* is a technical term for the statistical study of populations, usually restricted to physical conditions, or vital statistics, though sometimes applied to studies of moral and intellectual conditions.

*Biometry* is the application of statistical methods to the problems of biology. "The real purpose of biometry is the general quantification of biology. Its fundamental viewpoint is that without a study of the quantitative relations of biological phenomena in

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<sup>1</sup> W. H. Guilfooy, *Vital Statistics in the Promotion of Public Health*, in the *New York Medical Journal*, Nov. 5, 1910.

<sup>2</sup> John W. Trask, *Vital Statistics, a Discussion of what they are and their Uses in Public Health Administration*. U. S. Public Health Service, 1915.

the widest sense, it will never be able to arrive at a full and adequate knowledge of those phenomena."<sup>1</sup>

II. *Social statistics* are closely related to vital statistics and dependent upon them for basic data. They cover movement of population, immigration, housing, delinquency, the various phases of child welfare, community organization, public health and mental measurements.

III. *Educational statistics* also include mental measurements, whose results are increasingly important for educational policies; they include further such administrative matters as attendance, retardation, school-leaving, school expenditures.

IV. *Business statistics* is a blanket term to cover statistics as concerned with the production, buying and selling, financing, transportation and advertising of commodities. *Industrial statistics* cover production—plant management and operating statistics, accident statistics, statistics of wages, hours of labor, labor turnover, etc. They may include also the buying of raw materials and marketing of products. For the problems of marketing, *commercial statistics* is, however, the usual term. It covers not only wholesale transactions but the whole organization of retail buying and selling with advertising and transportation. *Financial statistics* are primarily concerned with bank transactions, stocks and bonds, exchange, etc., but depend also upon industrial and commercial statistics, as production, transportation and trade are closely interdependent with all financial transactions. Indeed industrial, commercial and financial statistics are all interwoven.

*Agricultural statistics* analyze the facts concerning acreage, tillage, soil, weather, crops, markets, farm management; statistical methods are also relied upon in agricultural experimentation leading to such practical conclusions as that corn grown from seed from ears ten inches long has, on the average, longer ears than corn grown from seed from ears that are eight inches long; or that a farm of less than forty acres in a certain district is economically undesirable.

These various kinds of statistics are closely interrelated and overlap to a considerable extent in the current uses of the terms. In a specific position a statistician may be concerned with one or several or all of them.

<sup>1</sup>Raymond Pearl, *The Service and Importance of Statistics to Biology*, in the Quarterly Publication of the American Statistical Association, March, 1914.

*Research Worker.* According to the dictionary this is a general term applied to anyone engaged in critical inquiry, in seeking facts or principles in any field; and the statistician may be described as a research worker who collects and classifies facts on the basis of relative number or occurrence as a ground for induction. There are forms of research which are entirely statistical, in a large number of instances other than statistical facts are sought. Statistical methods of investigation with quantitative and therefore more definite measurements are increasingly respected and applied in a constantly widening range of data which had not been recognized as lending themselves to quantitative treatment.

In practice, the term research worker is used without specific characterization, to designate the worker engaged in any kind of investigation or organization of material; it may have a less professional connotation than statistician, loosely as the latter term is used, it may be used as synonym for, or in combination with statistician; in more limited instances, notably in science, it really connotes "critical inquiry" in seeking facts whether quantitative or qualitative. A trained statistician can usually carry on research for qualitative as well as quantitative facts in the fields he knows, and must indeed frequently take into account qualitative considerations in interpreting quantitative facts. A research worker is very likely to be handicapped sooner or later without a knowledge of statistics.

## PART IV.

### Fields in which Statistical Workers are Employed

**S**TATISTICS is recognized as concerned with social phenomena, in discussing the fields in which statistical workers are employed; therefore the natural sciences, engineering, architecture, in which statistical methods are used, are not included.

The work of many of the organizations which are included is purely statistical; others conduct varied research of which statistics is an important part.

The plans for statistical departments or research departments vary a great deal in different organizations, and the positions described in the previous section are found combined in a large variety of ways.

The different government departments and lines of business included below do not in most cases involve work of essentially different character, but rather work dealing with different varieties of material.

Transition from one field to another in statistical work, depends largely upon general background. It is easier in the earlier stages of advancement, for general method is readily applicable in different fields. For responsible work an intimate knowledge of the field is essential and transition depends upon versatility. A statistician equally versed in educational theory and practical economics can transfer from research in education to organizing a statistical department in a financial organization. Government positions are generally considered invaluable for training especially in method and knowledge of sources. From government departments women have transferred to important statistical positions in business, education and social work. A woman will ordinarily, however, advance farthest if she decides in what field she will apply her statistical knowledge rather than to consider statistics as an end in themselves.

#### GOVERNMENT DEPARTMENTS

The Federal Government is the largest single employer of statistical workers. They are found in practically every branch of the Government service. The public depends upon the reports of

the various bureaus for statistical information in regard to resources, production, manufacture, commerce, population, education, and government. Since statistics are fundamental to an understanding of all economic and social matters, it is impossible to overemphasize the importance of the statistical work of the Federal Government and the necessity for broad training and vision to make it of the utmost public service.

April 1, 1919 101 "statisticians" and 1,573 "statistical clerks" were employed in Government offices in the District of Columbia. Both of these terms are liberally used in the civil service nomenclature and each covers a variety of actual positions. In a recent civil service examination for "statistical clerk" the following ratings were applied: practical tests in statistical computation, 40%; tabulating statistical data, 40%; education and experience, 20%. In the same examination requirements in skill for "junior statistician" were almost as great, fundamental background counting less than half. The ratings were: practical tests in statistical computations, 20%; statistical methods, including theory of statistics, 20%; thesis, 10%; education and experience, 30%. The number of scientific statisticians in the Government service is probably considerably smaller than the title used would imply.

The need for more specific classification and for reorganization of Government personnel administration has been recognized by Congress and at present several measures for meeting this need are under consideration. Since the Civil Service Commission ruled in November, 1919, that women are eligible for entrance to all examinations equally with men, the chances for women in the service are improved; department heads may still exercise a sex preference, however, and in practice the chances of women are not yet equal. The number of lower statistical positions from which a woman can start increased rapidly during the war, and in the Government service as elsewhere much now depends upon the individual woman's demonstration of ability.

The following chart, the information for which was taken from the thirty-fifth, thirty-sixth and thirty-seventh annual reports of the United States Civil Service Commission, shows the number of examinations and appointments of women for statistical work for the fiscal years 1918, 1919 and 1920.

Statistical divisions are organized on widely different plans, according to the information to be collected and in a measure also according to the vision of the responsible superior officers. The volume of data handled in a number of statistical divisions in Government departments is so large that the routine work is specialized

NUMBER OF WOMEN EXAMINED, NUMBER THAT PASSED, AND NUMBER APPOINTED TO POSITIONS IN  
STATISTICAL WORK IN THE FEDERAL CIVIL SERVICE DURING THE FISCAL YEARS  
ENDING JUNE 30, 1918, 1919 AND 1920.

Kind of Examination	Number Examined			Number Passed			Number Appointed					
							Departmental			Field		
	1918	1919	1920	1918	1919	1920	1918	1919	1920	1918	1919	1920
Accounting and Statistical Clerk .....	10	36	12	10	17	2	2	6	5			1
Clerk Qualified in Statistics...		110	1		100			33	6		10	1
Economist's Assistant .....		32			20			1				
Senior Statistical Clerk.....		2			2			1				
Statistical Agent .....			5			1						
Statistical Assistant .....			58			36			1			
Statistical Clerk .....	222	639	64	79	245	21		87	61		4	17
Statistical Draftsman .....	15	8		11	7		3		3			
Statistical Expert .....		10			1							
Statistical Machine Operator...	19	4		19	4		4	2				
Statistician .....	19	49		19	49		2	11			1	

and separate sections are organized for checking, coding, machine tabulating and sorting, or statistical drafting. In departments where few statistics are required, on the other hand, they may be handled by members of the staff as incidental to their regular assignments. The departments of the Government which continuously conduct statistical investigations will be considered separately.<sup>1</sup>

#### DEPARTMENT OF STATE

In the office of the Foreign Trade Adviser in the Department of State is centered the control of the commercial work of diplomatic and consular officers. Consular and diplomatic communications on economic and commercial matters are indexed and edited and sent to the departments of the Government concerned in the various matters involved. They are edited also in the Department of Commerce for the publications of the Bureau of Foreign and Domestic Commerce. The office of the Foreign Trade Adviser connects the Department of State with the other Government offices interested in the reports of the diplomatic and consular offices on economic, social, commercial, and financial matters.

The office maintains a special assistant for the editing, acknowledgment, and distribution of diplomatic and consular trade reports with clerical workers who collect and classify such reports.

#### DEPARTMENT OF THE TREASURY

*Federal Reserve Board.* The Federal Reserve Board maintains a division of analysis and research in New York with a director and a staff of about fifteen assistants, and a division of reports and statistics in Washington with a statistician as chief of the division, an associate statistician and about thirty assistants. The statistical work of these divisions is based upon reports from member banks, reports of foreign banks, of domestic and foreign trade, exchange rates, prevailing discount and interest rates, and the current banking, trade, and financial situation in general.

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<sup>1</sup> For information in regard to Government departments see Edith Guerrier, *The Federal Executive Departments as Sources of Information for Libraries*, Bulletin 1919, No. 74, U. S. Department of the Interior, Bureau of Education.

Dr. George C. Havenner of the U. S. Bureau of Efficiency is preparing a bulletin on the statistical work of the Government which will be ready for publication soon. Part I will analyze the statistical work of the Government by subjects, Part II by Government units which collect statistics.



The annual report of the Federal Reserve Board is largely based on reports of member banks and contains much statistical material, such as a comparison of the gold reserves required against Federal Reserve notes in circulation, the cash reserves required against Federal Reserve note and net deposit liabilities combined, and the total cash reserves held by Federal Reserve banks; a comparison of the daily number and amount of items handled by Federal Reserve banks over a period of years. There is published also a monthly Federal Reserve Bulletin. Each issue contains a review of the month covering business, industry, and finance; prices, discount and interest rates, a foreign trade index, a report of the operations of the Federal Reserve clearing system, and the resources and liabilities of Federal Reserve banks. Two women reported their work for the Federal Reserve Board as follows:

Position	Duties
Research assistant and translator.	Making tables of bank reports and other financial reports, domestic and foreign; financial research involving the translation of foreign material.
Research assistant, Bureau of Analysis and Research.	Instituting a system of reporting international prices.

*The Comptroller of the Currency.* The office of the Comptroller of the Currency is headquarters for statistics of all banks other than Federal Reserve banks; these are the basis for the annual reports of the Comptroller of the Currency. There are 19 women and 9 men engaged in the Statistical Division of this office (January, 1921). The Division of Loans and Currency keeps statistics of money in circulation, per capita distribution and other data in regard to the stock of money in the United States.

*The Public Health Service.* The Division of Research of the Public Health Service gathers information from many sources and conducts field investigations and experiments in matters of health—the handling of epidemics, keeping water supply pure, reducing occupational diseases, feeding and caring for children. This service publishes many health bulletins: for example, a report of a physical examination of 679 male minors under 18 in the cotton industries of Massachusetts to determine the influence of occupation on health during adolescence; a report on infectious diseases of children based on a study of 6,078 cases among immigrants with special reference to cross infection and hospital management; a

study of smallpox in the United States, its prevalence and geographic distribution during the calendar year 1911; bulletins on strength tests in industry and sickness and absenteeism in industrial establishments. The service also publishes a weekly public health report.

"There are 59 statistical workers employed in the Bureau of Public Health. There are 7 highly trained statistical workers in the Division of Scientific Research, 2 of whom are women. In the Hospital Division 46 out of the 52 employed are women. Of this total number (52) in the Hospital Division, 7 (5 of whom are women) are engaged in purely statistical work requiring statistical training. The others are engaged in clerical work incident to tabulation, compilation of records such as coding, punching, machine tabulating, filing, searching, etc."

*United States Customs Service.* Among the various duties of the Customs Service is the compilation of statistics of customs duties, imports and exports, tonnage of vessels, and shipments between the United States and its insular possessions. The reports of the country's exports and imports which are compiled by the division of customs statistics in New York are material of primary importance to the Department of Commerce. There are 93 employes in this division, of whom 40 are women. No statisticians are employed, as the work consists more in the preparation of reports on machines, of statistics furnished by the various customs districts throughout the United States, than in the actual gathering and classification of statistics. It has been recommended in the present administration that this bureau be taken over by the Department of Commerce.

*Bureau of War Risk Insurance.* The Government is conducting in this bureau the largest insurance enterprise in the country. Although instituted to meet war-time needs, the provision for converting war-time insurance into permanent life and disability insurance has made this bureau one of great peace-time activity. As is indicated, in the following summary, the statistical work of this bureau is very largely routine work.

The bureau employs 3 statisticians, one in the director's office, one in the medical division, and one, a woman, in the personnel division. The total number of statistical workers is 176, 60 of which are statistical clerks, 9 statistical draftsmen, 48 abstracting clerks, 26 coding clerks, 24 key punch operators, 2 sorting machine operators, and 7 tabulating machine operators. Practically all of these are women.

"They are engaged in compiling daily, weekly, monthly, quarterly, annual, and special reports concerning compensation and insurance claims received, pending, and allowed; medical cases examined, and hospitalization; insurance premiums paid and insurance converted; checks mailed; data relative to the personnel, labor turnover, and salary expenditure; other work reports for the various divisions" (April, 1921).

#### DEPARTMENT OF WAR

*The Adjutant General's Office.* This office, which has custody of the records of every organization in the military service, as well as those of each individual member of every organization, is the original source of all statistical information regarding the strength, gains and losses of the entire military establishment of the United States as well as data showing the numerical strength of the military personnel at all camps, posts, etc.

The Statistical Section of the Mail and Record Division at present (January, 1921) includes 16 clerks, of whom 13 are women. The chief of the section (a woman) is rated by the Civil Service Commission as a "Statistical Clerk."

*Office of the Chief of Staff.* The Statistics Branch of the General Staff publishes to the service every other Saturday a confidential report containing statistical information of a military nature, concerning the army at present or such factors as may affect it in the future. There are 6 commissioned officers and 6 clerks employed in this branch; 5 of the clerks are women.

One woman with the title statistical draftsman is engaged in statistical compilation and the checking of reports in this office and superintends a group of draftsmen.

*Office of the Surgeon General.* The division of sanitation of this office handles the vital statistics of the army; they are published currently from week to week, and grouped into permanent form for the annual report. It is difficult to tell what the peace time status will be, as much work is still being done in preparing the medical and surgical history of the war. There is much subordinate work in this division.

"In the current statistical section, one officer, who has received training in the statistical work is employed, and he is assisted by two clerks, one male, and one female, neither of whom is an expert statistician."

*Office of the Judge Advocate General.* There is a statistical section in the Office of the Judge Advocate General, the work of which consists of the collection, compilation, and analysis in clear and convenient form of data from the records of all cases tried by general courts-martial. This work is now done by one officer and two clerks, one of whom is a woman.

*Army Transport Service.* One woman employed in the Transportation Service is located in a harbor city. Her work consists of building up new forms and tables, deciding what data to include in reports, compiling cost and operation reports relative to water, rail, and animal drawn transportation.

#### DEPARTMENT OF THE NAVY

*Office of Naval Operations.* There is one statistical clerk in the Ship Movements Division of this office, and three in the Gunnery Exercises Division, who collect data in regard to engineering and gunnery exercises and in regard to cruising, alterations, status, etc., of naval vessels.

*Bureau of Supplies and Accounts.* One statistician and three clerks on statistical work compile data in connection with naval expenditures in this bureau.

*Compensation Board.* Three statistical clerks compile actual costs of naval vessels being constructed on cost plus contracts; they also classify and compare such costs at different periods and in different yards.

*Secretary's Office.* Three statistical clerks in the secretary's office are employed in compiling records in connection with numbers of employees at navy yards and stations.

*Marine Corps Headquarters.* One statistical clerk compiles data in connection with the recruiting service of the Marine Corps.

*Navy Property Accounting Office.* A statistician is employed in this office to obtain and organize data on naval expenditures.

*Bureau of Medicine and Surgery.* In the Bureau of Medicine and Surgery 14 statistical clerks collect morbidity and mortality reports of the navy and marine corps.

*Bureau of Navigation.* A statistician and 41 statistical clerks are engaged in this office in collecting and arranging statistics regarding office and enlisted personnel of the navy.

## DEPARTMENT OF THE INTERIOR

*Bureau of Education.* The Bureau of Education reviews a vast amount of educational data in its division of statistics. A biennial survey of education is prepared dealing with summer schools, schools for the deaf, blind and feeble-minded, industrial schools for delinquents, private high schools, state school systems, normal schools, nurse training schools, private commercial schools, public high schools, city school systems, colleges and universities.

The recently published volume *Statistics of City School Systems*, a section from this biennial survey, presents statistics for the school year 1917-1918 of the public schools in all cities which had a population of 2,500 or over in 1910. One phase of this report illustrates the possible significance of such a survey. An analysis was made of the pupils under age, of normal age, and over age in 1908 and in 1919, which indicates that the per cent of under-age pupils in cities has increased in every instance. This result correlates with two items; a greater flexibility in school curricula, permitting pupils to advance from grade to grade as soon as they have mastered the required subject matter, and the earlier enrollment of children in school as indicated by the increased percentage of children 5, 6 and 7 years of age enrolled in school in 1918. The percentage of over-age pupils has decreased, which fact is closely related to the decided decrease of all pupils 11, 12, and 13 years of age within this ten-year period. Retarded, over-age pupils are evidently dropping out of school at these ages when most compulsory attendance laws become less effective. The smallest percentage of over-age pupils is found in the first grade and the highest percentage in the fifth grade, where over 30% of the pupils are retarded; in the seventh and eighth grades the percentages decrease rapidly. The large proportion of all children out of school from the age of 13 on is in itself an important indication of the need for improvement in our educational system, and is the basis of all plans for continuation and part-time schools. The report indicates that only one per cent of a city school's expenditure is now devoted to provision for further education of this large group out of regular school from the age of 13.

This bureau publishes each year also a number of special bulletins on matters of domestic and foreign education, many of which include statistical material, such as: *A Survey of Education in Hawaii, 1920*; *Education for Highway Engineering and Highway Transport, 1920*; and *Requirements for the Bachelor's Degree, 1920*. The statistical work of this bureau has been following prescribed forms and is largely on a fixed basis. Private educational

agencies have pointed by example to the kind of significant statistical work which the Bureau of Education might do with increased support for the development of its services.

One woman reporting for this study is in the Bureau of Education and describes her work as including the sending out of questionnaires, tabulating returns, and preparing summaries. Her work requires a good understanding of different systems of city schools.

*Reclamation Service.* The reclamation of three millions of acres of arid land is the work with which this service is engaged. Already over twelve thousand miles of canals, ditches, and drains including ninety-three thousand canal structures, have been built. One hundred storage and diversion dams have been constructed. At present approximately one hundred and twenty thousand persons are living on the thirty thousand farms irrigated by the service. The Reclamation Record is issued the first of the month by this service. Statistics regarding farms, cost, and terms of payments, are available upon request.

"In this service there are no employes engaged exclusively on statistical work. Statistical data are prepared in different divisions, e. g., financial data in the accounting division, engineering data in the technical division, and so on, but this work requires only a portion of the time of those who may be assigned to it."

*Bureau of Mines.* "There is one petroleum economist who handles all petroleum statistics, and one mine statistician who is in charge of the statistical section which is made up of 4 women statistical workers. In this section the work consists of reports on number of men employed, days of labor performed, and number killed and injured, by causes, for all metal mines and metallurgical works, quarries, and coke ovens; the production and distribution of explosives; and the fatal injuries in all coal mines; together with rates, averages, and percentages based on these figures."

The Bureau of Mines prepares various special reports on such subjects as Coal in the British Isles, A Miner's Yearly and Daily Output of Coal, and statistics on petroleum products.

*The Geological Survey.* One of the most important duties with which the United States Geological Survey has been charged is that of making an inventory of the country's mineral wealth as utilized in the mineral industries. The division of mineral resources compiles a continuing statistical record of the mineral pro-

duction of the country, including weekly and monthly reports on production of coal, and reports new sources of minerals or new methods of their utilization. The field covered includes every known raw mineral product and commodity of economic value and anticipates future development by including some rocks and minerals that are of no present economic value, but that may be valuable in the future. The Survey's lists now contain approximately 110,000 names of mineral operators, all of whom are in direct touch with the Survey, not only supplying information but receiving it. A recent expansion of the work provides for the preparation of more detailed and frequent current domestic statistics and more exhaustive research into foreign mineral resources. The division of mineral resources employs 36 statistical workers.

*Office of Indian Affairs.* "This office compiles and embodies in its annual report a number of statistical tables relating to population, schools, vital statistics, agriculture, property, income, hospitals and sanatoriums, law and order, employment and miscellaneous matter. The material for those statistical reports is gathered by means of questionnaires sent out each year to the superintendents in charge of the various Indian reservations and schools, supplemented by the records of the Commissioner's office.

"The statistical work of the office is in charge of a statistician, to whom is detailed clerical assistance when necessary. No staff of statistical clerks is maintained."

#### DEPARTMENT OF AGRICULTURE

Probably the best known Government reports are those issued by the Department of Agriculture. They cover every phase of farm conditions, farm management, the production and marketing of farm products, commerce in the agricultural products of various countries, the development of agricultural resources, agricultural insurance, and conditions of tenancy. There are in the Department of Agriculture some 300 statisticians, statistical clerks or clerks employed in statistical work.

*Bureau of Crop Estimates.* The Government Crop Reports, made monthly during the crop season in the Bureau of Crop Estimates are of great importance to industry and business. "Prompt and reliable information regarding crop prospects is equally important and valuable in the conduct of commercial, industrial and

transportation enterprises. The earlier the information regarding the probable productions of the great agricultural commodities can be published, the more safely and economically can the business of the country be managed from year to year. . . . With such information carefully and scientifically gathered and compiled, and honestly disseminated, the farmers, the merchants, the manufacturers and the transportation and distributing agencies of the country can act with a degree of prudence and intelligence not possible were the information lacking."<sup>1</sup>

This bureau maintains a staff of 50 to 60 field workers who secure a large part of the data upon which crop estimates are based, and a larger staff at headquarters which combines and analyzes field reports obtaining averages from samples. Much of the work is routine, such as copying figures from schedules to large sheets, which requires considerable information and judgment in agricultural matters. The field work and the administrative work are at present done by men. The Bureau of Crop Estimates prepares also various bulletins, such as Statistics of Grain Crops, Imports and Exports of Agricultural Products, and crop summaries for the yearbook of the Department of Agriculture.

*Bureau of Markets.* The Bureau of Markets issues reports in the weekly Market Reporter and in special bulletins on the supply, commercial movement, receipts, disposition, and market prices of fruits and vegetables, live stock and meats, dairy and poultry products, hay, feed, and seeds, on cold-storage holdings and on opportunities in foreign countries for American producers of farm products. Several women have carried responsible statistical assignments very satisfactorily in the preparation of these reports. The statistical work of this bureau is being unified and reorganized and will probably be amalgamated with that of the Bureau of Crop Estimates.

*Bureau of Public Roads.* The Bureau of Public Roads gathers information and statistics covering the construction and maintenance of highways, the utilization of convict labor in road management, mileage of roads, number of bridges built, sources of funds and distribution of expenditures for public roads, registrations and number of motor cars and total motor-vehicle revenues.

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<sup>1</sup> Government Crop Reports: Their Value, Scope and Preparation. U. S. Department of Agriculture, Bureau of Crop Estimates, Circular 17, Revised.



*Bureau of Farm Management and Farm Economics.* Investigations are conducted by this bureau which are primarily concerned with the improvement of farm practices; studies in the cost of production of various crops and farm animals, the cost of farmers' living, the status of tenancy in the United States and underlying principles of tenant farming, factors that make for efficiency in the use of farm power, and agricultural geography. There are research workers, assistants and statistical clerical workers in this bureau, with a separate division for the large amount of statistical drafting required for condensed presentation of data. One woman trained in geography, economics and statistics is preparing independently a bulletin on Indian lands, railroad lands, etc., which are at present for sale. When she has gathered various data in regard to these lands she sends them to the drafting room to be analyzed and put into the form considered by the chief of this room most desirable for the presentation of this particular material.

Another woman has been working under direction on information in regard to farm products which should be considered in modifying tariff legislation.

Women have assisted in preparing the three sections which have so far appeared of the comprehensive Atlas of American Agriculture.

*Weather Bureau.* A function of the Weather Bureau is to publish statistics relating to rainfall, temperature, winds, etc. These statistics serve a great variety of purposes and are consulted by mariners, physicians, agriculturists, engineers, and the public in general. There is no statistical division in this bureau. While many of the clerks are required to make mathematical computations and tabulations, such work is incidental and does not constitute their main duties.

*Bureau of Animal Industry.* There is a statistical worker in the division of dairy engineering in this bureau who makes special studies of the trend of milk production, the dairy-cattle industry, the butter industry, the cheese industry in the United States and other countries, and keeps statistics of the balance of trade in dairy products between the United States and foreign countries.

The work that women are doing in the Department of Agriculture may be illustrated further by an outline of three positions held in this department and the duties performed in them by women who gave information for this study.<sup>1</sup>

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<sup>1</sup> See also pages 122, 124.

Position	Duties
Statistical Research Clerk, Bureau of Crop Estimates.	Compilations along lines of special investigations of the Bureau requiring an understanding of what the investigator has in mind; preparation of statistical tables for the printer; research work requiring a knowledge of statistical sources of information, United States equivalents of foreign weights, measures and values; indexing, charting, and proof-reading.
Statistical Clerk, Office of Farm Management.	Research and compilation of results, preparation of maps showing agricultural condition and commerce in agricultural products of various countries.
Statistical Clerk and Stenographer.	Stenographer to the chief of a section with frequent statistical assignments.

#### DEPARTMENT OF COMMERCE

*Bureau of the Census.* This bureau is probably the greatest statistical office in the world. It is responsible not only for the decennial enumeration of the population of the country with age, sex, occupations, wealth, taxation, public debt, etc., but also for a decennial census of agriculture and quinquennial census of manufactures. The vital statistics of states and cities are collected, tabulated and analyzed;<sup>1</sup> numerous special statistical inquiries required by law or by Congress are conducted, as for example monthly and semi-monthly cotton and cotton-seed statistics, quarterly tobacco statistics, an investigation of the proportion of the population which owns its homes. Recent publications of the bureau are reports of cotton-production in the United States, crop of 1919, of the financial statistics of states, 1919, of the stocks of leaf tobacco and the American production, import, export and consumption of tobacco and tobacco products, 1919.<sup>2</sup> The reports of the Bureau of the Census are very widely used as fundamental social and economic data.

<sup>1</sup> See John W. Trask. *Vital Statistics, a Discussion of what they are and their Uses in Public Health Administration.* United States Public Health Service, 1915.

<sup>2</sup> See Catalogue of Publications of the Bureau of the Census.



A vast amount of work is required for the collection, analysis and presentation of data in these inclusive reports.<sup>1</sup> March 31, 1921, the total number of employees was 2,830, of whom 2,024 were women. The positions held by them were as follows:

Expert chiefs of divisions at \$2,500 per annum....	3
Statistical experts at \$2,000 per annum.....	7
Stenographers at from \$1,500 to \$1,800 per annum	5
Clerks at from \$900 to \$1,800 per annum.....	1,549
Operatives at from \$900 to \$1,380 per annum....	451
Sub-clerical at from \$720 to \$1,000 per annum....	3
Special agents at from \$3 to \$6 per diem.....	6
	<hr/>
	2,024

A large proportion of these employes are temporary and needed for work on the decennial census. During intercensal periods the force has consisted of between six and seven hundred employes.

The work is organized into specialized divisions, with supervisors who are in some instances women. In the census of manufactures, for instance, schedules are prepared by the director and his assistants with the co-operation and advice of the industries concerned. These schedules are sent out by mail and when replies are delayed or unsatisfactory, field agents follow. The returned schedules are checked, edited and coded by different specialized workers, then sorted and tabulated by machines. The condensed results go to members of the staff, each charged with particular industries, who prepare the final reports. There are, for instance, women who are in charge of silk, buttons, needles and pins, and meat industries, who write the reports for the statistics of the manufacturing of these products. They are not responsible for schedules, table forms or compilation processes, but for the report writing. This implies a knowledge of the industry, acquired chiefly by experience in the bureau, though in some cases by experience in the industry, and a grasp of the statistical items. A chief of a division in this bureau described her work for this study: "preparing instructions regarding the various processes of population statistics or special investigations and editing the text which other workers prepare." Imagination, with a funda-

<sup>1</sup> For a description of the organization for the fourteenth decennial census see the Annual Report of the Department of Commerce, 1920. Also, the second report of the Joint Census Advisory Committee of the American Statistical Association and the American Economic Association, Quarterly Publication of the American Statistical Association, December, 1920.

mental training in economics is essential for understanding the significance of these statistical reports and for planning such analyses as will make them of the utmost possible service.

The administration of the Bureau of the Census is working toward the improved serviceability of census reports. At the request of the Secretary of Commerce, 6 members have been appointed by the American Statistical Association and the American Economics Association to serve as an advisory committee of the census. The guiding policies of this committee are (1) to aid the Bureau of the Census to expedite the publication of the basic tables relating to population, agriculture, and manufacture, (2) to aid the bureau to secure an adequate scientific analysis of the data, a matter of pressing importance in deciding the value and character of the fourteenth census.<sup>1</sup>

*Bureau of Fisheries.* This bureau prepares statistical reports on the fisheries of various sections of the country, with special reports such as "a statement of the quantity and values of certain fishery products landed at Boston and Gloucester, Massachusetts, and Portland, Maine, by American fishing vessels during the month of May, 1920."

*Bureau of Foreign and Domestic Commerce.* The division of statistics of the Bureau of Foreign and Domestic Commerce, with some 30 employes, analyzes the trade of the United States with the world, showing the imports and exports by articles in the trade with each foreign country. Monthly and annual reports are prepared, based upon the returns of customs officers. Since the relation is so close between the statistical work of this division and that of the Bureau of Customs Statistics, it has been recommended to Congress that the two offices be amalgamated in the Bureau of Foreign and Domestic Commerce.

The research division of the Bureau of Foreign and Domestic Commerce deals with statistics of foreign countries, and such questions relating to the trade of the United States as come to the bureau. If, for example, the bureau were asked what dyes Germany exports now, the research division would find the correct answer. There are at present (April, 1921) 14 employes assigned to duty in the research division, 9 of whom are women.

The bureau sends out trade commissioners for the investigation of special subjects and has commercial attaches stationed in various

<sup>1</sup> See first report of the Joint Census Advisory Committee of the American Statistical Association and the American Economic Association, American Economic Review, Supplement XI, March, 1920.

foreign countries. From the reports of these agents and of the consuls of the State Department as well as from foreign trade reports, customs reports, and various other sources, current trade information is compiled.

The bureau has been preparing pamphlets giving the titles and descriptions of the principal statistical publications of foreign countries, and the methods used by each important country in computing the values reported in its foreign trade statistics. The publications of the bureau include the daily bulletin Commerce Reports, a monthly summary of the foreign commerce of the United States, an annual pamphlet giving prices of raw materials in the leading markets of the United States, an annual Statistical Abstract of the United States, with various special reviews of trade and bulletins such as: Jewelry and Silverware in Cuba; Import and Export Schedules of Italy; Trade Opportunities in France, and A Commercial Handbook of China.<sup>1</sup>

One recent number of Commerce Reports contained information in regard to the paper and pulp situation in Sweden, the depressed condition of the rubber market in the Netherlands, coffee shipments from the port of Maracaibo, Venezuela, the general tendencies of Japan's foreign trade in 1920, the Czecho-Slovak cotton situation, Canada's leather, boot and shoe industry, Esthonian foreign trade for the last six months of 1920, the trade of Persia in vegetable oils and vegetable oil material, with a summary of one hundred years of American foreign trade.

One of the women employed in this bureau described her work as including the compilation of data from records received from collectors of customs showing export and import returns, and from various other Government sources, covering every commodity in the commerce of the world; compilation of tables and writing of reports.

#### DEPARTMENT OF LABOR

*The Bureau of Labor Statistics.*<sup>2</sup> The Bureau of Labor Statistics is the most important center for statistical information on prices, cost of living, wages and hours of labor, employment and unemployment, workmen's insurance and compensation, industrial accident and hygiene, women in industry, conciliation and arbitra-

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<sup>1</sup> See Catalogue of Publications of the Bureau of Foreign and Domestic Commerce.

<sup>2</sup> See Royal Meeker, Some Features of the Statistical Work of the United States Bureau of Labor Statistics, in the Publication of the American Statistical Association, March, 1915.

tion, labor laws of foreign countries and the United States. The price index which this bureau has maintained since 1907 is standard.

The bureau publishes a *Monthly Review* including statistics on the various subjects enumerated; in addition, special bulletins on these and related subjects are periodically printed. Some of the investigations for all these various reports are purely statistical, others are more general, using statistics only in part. A study of *Housing by Employers in the United States*, recently published, for example, summarizes reasons why employers have supplied workmen's houses, and gives full descriptions of the various types of housing development, including the site and planning of towns, race segregation, public utilities, schools, churches, playgrounds, and hospitals. There are included statistical comparisons of the types of houses provided, the size of dwellings, the material of construction, the provision of sanitary systems, rents, methods of financing, proportion of labor force affected. Eleven groups of industries are separately analyzed.

There are about 40 statistical workers in this bureau, of whom a number are women. Two women, for example, are in charge of retail price statistics, each responsible for a certain group of commodities; one woman does editorial work for the bureau, which requires an understanding of statistics. There is a large amount of subsidiary work as in other departments, operating machines, drafting, etc.

*The Children's Bureau.* The Children's Bureau was created "to investigate and report upon all matters pertaining to children and child life among all classes of people," and to study especially such specific questions as infant and maternal mortality, juvenile courts, dangerous occupations, accidents and diseases of children, and employment. This bureau prepares valuable reports on these and other matters related to child welfare. The statistical division of about 20 workers does not initiate investigations nor prepare reports, but advises with divisions which are entering upon investigations as to schedules and forms, and carries out all compilation and charting of data. "Save the Youngest," a bulletin containing seven charts on maternal and infant mortality with explanatory comment, is an interesting example of the statistical work of this bureau.

Two women who contributed information for this study secured excellent experience in the Bureau of Labor Statistics as field investigators; one has been transferred to the position of sta-

tistical clerk in the Children's Bureau, where she has been preparing tables from first tabulations of material from schedules on a report of infant mortality, rearranging the material in larger groups.

*The Immigration Bureau.* Eight clerks are regularly employed with statistics in the Immigration Bureau in Washington. The statistics of the field offices are prepared by the regular forces employed in those offices. The statistics of this bureau cover immigrant and nonimmigrant aliens admitted into the United States, and emigrant and nonemigrant aliens departing from the United States with data as to nationality, sex, age, occupation, financial condition, admissions and rejections, and literacy.

*The Bureau of Women in Industry.* This bureau gathers important information in regard to the conditions surrounding women workers; legal working hours for women, minimum wage laws for women, night work laws for women, the status of women as state labor officials, women in the Government service and all related matters. This information is available in the bulletins and maps published by the bureau. A woman with training in the Bureau of Labor Statistics is in charge of the statistical division, with five assistants.

#### THE DEPARTMENT OF JUSTICE

In the Department of Justice approximately 40 clerks are engaged in statistical work. They are employed principally (1) in the division of accounts, in which statistical information showing the business transacted in the courts of the United States, bankruptcy statistics, and the various reports required by law pertaining to expenditures under appropriations for the courts are compiled for use in the annual report; (2) in the office of the disbursing clerk, where funds from about forty appropriations are disbursed, and (3) in the office of the appointment clerk, who has charge of all matters relating to applications, recommendations, and appointments, and compiles the Register of the Department of Justice.

#### THE POST OFFICE DEPARTMENT

There are 16 statistical clerks employed in the Post Office Department in Washington, compiling statistics of the operations of the postal service.

## GOVERNMENT COMMISSIONS AND BOARDS

In addition to the major departments of the Government there are various special boards and commissions, the progress of whose work rests to a great extent upon statistical reports.

*Interstate Commerce Commission.* There are approximately 9 statisticians and 75 accounting and statistical clerks employed by the Interstate Commerce Commission. Their duties are "to compile returns from reports submitted by steam, electric, express and pipe line, telephone, telegraph and carriers by water; preparation of various accounting and statistical statements; checking, examining and correcting reports." These reports include monthly statements of revenues and expenses; employes, service and compensation; operating statistics by regions. Railroad experience is important for the statistical work of the commission, especially for comprehension of units of measurement used—freight train-miles, loaded freight car-miles, locomotive miles, net and gross ton-miles, etc. An Abstract of Statistics of Common Carriers is prepared each year summarizing the reports of steam railway companies and the annual reports of the principal express companies and of the Pullman Company. The annual report, Statistics of Railways in the United States, summarizes mileage, receiverships, equipment, employes, capitalization of railway property, traffic and operation statistics, income and profit and loss statements, taxes and assessments, investment in road and equipment, and miscellaneous matters pertaining to railways.

*The United States Tariff Commission.* This commission reports, among the activities of the fourth year of its existence, investigations into various subjects, including colonial tariff policies, commercial treaties, and reciprocity with Canada. It has continued its study into the wool-growing industry throughout the world and has in progress a thorough investigation of special or preferred transportation rates by railroads in the United States and in foreign countries and by carriers upon the ocean in order to determine what relation, if any, such rates may have to the tariff. Two reference books have been prepared for Congress, Summary of Tariff Information, 1920, and Statistics of Imports and Duties, 1908-1918, Inclusive. In foreign countries investigations have been made of the British wool-manufacturing industry, silk production and manufacture in Europe, British metal and chemical industries, and the industries of Japan.

Tariff information surveys have been made embracing a large number of commodities under these general divisions; chemicals,



oils and paints, earthenware and glassware, metals, wood, cotton, sugar and molasses, flax, hemp and jute, and wool, with the manufactures of each; agricultural products; silks and silk goods; paper and books; sundries.

There are approximately 25 statistical workers regularly employed by this commission in addition to the experts who are employed in the preparation of special studies.

One woman reporting for this study is analyzing cost accounts and price data from figures sent in by various industries. Another is statistical clerk for a wool expert; she receives all schedules (confidential) sent out by the commission, tabulates the information contained in them, and finds the cost of wool production for the years under consideration.

*Federal Trade Commission.* The principle laid down by the act creating the Federal Trade Commission is: "Unfair methods of competition in commerce are hereby declared unlawful." In administering this act the commission maintains two major divisions, the legal division and the economic division. In the latter a large number of trade and industrial inquiries are conducted which are inaugurated by the commission at the direction of the President, or by direction of the United States Senate or House of Representatives or both. More recently there has been added an export trade division in administration of the Export Trade Act of 1918, and during the war an enemy trade division.

There are no employees of the commission who are rated as statisticians, but in the economic division there are 22 economists, 43 accountants, and 56 clerks, all of whom do more or less statistical work. Among recent reports of the commission are cost reports on coal and a report on the causes of high prices of farm implements.

*The Federal Board for Vocational Education.* There are three divisions of the Federal Board for Vocational Education, the vocational education division for the promotion of vocational education in the States, the rehabilitation division for the vocational training and return to civil employment of disabled soldiers, sailors and marines, and the recently established industrial rehabilitation division for the vocational training and return to employment of persons disabled in industry or otherwise.

The statistical division assembles statistics for each one of these. For vocational education, statistics are compiled from state reports in regard to the types of schools federally aided, the increase in the number of such schools, the distribution of teachers

and pupils compared for several years by states and in totals, comparative expenditures, allotments to states and unexpended balances. For the rehabilitation division, individual records of soldiers in training are the basis for statistical studies of enrollment, the general types of training, training agencies, employment objective, educational background, progress of cases. For the industrial rehabilitation division statistics will be compiled from state reports.

### SPECIAL WAR BOARDS

During the war a number of special emergency boards came into existence whose work immediately demanded the services of a large number of statisticians and statistical clerks. As examples may be cited the United States Shipping Board, the United States Grain Corporation, the War Industries Board, the United States Sugar Equalization Board, the War Finance Board, the Council of National Defence and, established under its direction and now an independent body under the charter of the National Academy of Sciences, the National Research Council.

A few illustrations of the many positions in statistical work held by women under these special boards follow:

Position	Duties
Statistician, Division of Planning and Statistics, United States Shipping Board.	Responsibility for the monthly publication of a printed report on the employment and control of vessels of 500 tons and over, trading with the United States.
Assistant Statistician, United States Sugar Equalization Board.	Preparation of weekly, monthly and quarterly reports on the sugar situation; special work on sugar history in other countries; graphical work.
Statistician, United States Grain Corporation.	Preparation of statistical reports on relief given to different European countries. Collecting data, summarizing and analyzing; preparing reports for publication.

### STATE AND MUNICIPAL GOVERNMENTS

Research workers, statisticians and statistical clerks are employed also in various divisions of state and municipal governments. They provide labor statistics as a basis for the policies and decisions of industrial commissions, arbitration and conciliation boards, minimum wage commissions; vital and social statistics for depart-

ments of health and departments of charities and corrections; statistics for departments of education; various data for public service commissions, departments of finance, banking and insurance departments, and departments of justice.

The following are illustrations of work women are doing in such departments:<sup>1</sup>

Position	Duties
Statistician in safety department of a state industrial commission.	Classifying and codifying of accidents; preparing all statistical tables required by the safety department; publication of bulletins.
Senior statistical clerk in state minimum wage commission.	Copying pay-roll records of women and minors in factories from pay-rolls. The records of pay for each week are totaled and the average weekly earning computed according to occupations, establishments, hours, age, experience, etc.
Statistician in public service commission.	Examination of data submitted by public utility corporations and making tables based on this information.

## BUSINESS

It is in industry and commerce that the specific problems of economics are actually met; questions concerning production and distribution, demand and supply in their varying relations, prices and their fluctuations, finance and credit, are both of immediate importance to the business organization and basic for economic theory. Business research is an effort to exercise direction and control over specific economic affairs through the use of intelligence. Statistical records help to eliminate the guess work; they substitute facts for impressions or recollections which are so frequently subject to partial or faulty and, therefore, misleading statement.

"The day of shrewd guesses in business is fast drawing to a close. The urgent demand now is for facts which have been carefully collected and scientifically analyzed, and which afford to the new business manager a solid basis for preparing his plan and administering his work. This means that the old rule-of-thumb methods must be discarded and that an approach, at least, to scientific analysis must be made."<sup>2</sup>

<sup>1</sup> See also page 121.

<sup>2</sup> C. S. Duncan, *Commercial Research*, 1919.

In a recent discussion of statistics in business<sup>1</sup> there have been suggested some investigations which would be conducive to intelligent business control: a statistical comparison in detail of highly profitable with markedly unprofitable territories or articles or methods; a statistical study of the relationships between seasonal slumps and net profit; an inquiry into the relative frequency of various characteristics of returned goods orders, to discover leading causes; analytical comparisons of records for the location of loss, wastes and inefficiencies; a statistical review of credit losses to locate clues for future guidance; a statistical study of the rise and fall in prices of basic materials, and of world and national supply volumes as guidance for the future course of prices. As concrete factors worthy of examination in any reasoning concerning differences in sales territories, there might be listed the population per square mile, the insurance in force per capita, the population per mile of railway, the per capita consumption of various articles, the per capita value of realty and personal property, the per capita school expenditure, the average number of days of duration of school in various localities, the number of enrolled pupils, the percentage of literacy, the number of savings bank depositors per thousand population, the average deposits for each depositor, the number of miles of improved roads, the marriage, birth and death rates. These common facts interpreted with imagination are transformed into new ideas and policies for business.

Business schools are recognizing the growing appreciation of statistics in business and are offering courses in preparation for their use, as may be illustrated by one quotation from a school catalogue:

"For the purpose of maintaining intimate and constant contact with all the parts of an organization, and as a means of making and testing business plans, progressive management must rely upon masses of data drawn from many sources and bearing upon a diversity of conditions both internal and external to a business. The usefulness of such data is determined not only by the degree of accuracy and promptness with which they are collected, but by the intelligibility of the form in which they are made available for use by executives. For these reasons, a sound knowledge of the principles, methods and devices of statistics and their many useful applications in business, is bound to be a valuable and often essential element in the training required for business. Moreover, the development of the statistical department in business organizations

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<sup>1</sup> J. George Frederick, *Business Research and Statistics*, 1920.

and the growing demand for expert statistical services are indications that the business statistician has gained the rank and earning power of a profession.”<sup>1</sup>

Business is a newer field for the application of statistics, but a developing one. Individual business firms which have appreciated the significance to management of collective facts are in increasing numbers establishing a research or statistical or data department within their own organization for the analysis of internal records and of such outside factors as are of concern in the conduct of their affairs. This is especially true of the larger business organizations—railroads, public utilities, large manufacturing concerns and mercantile establishments.

Other firms depend for research service upon the trade associations to which they belong; for analysis of their own records upon accounting and advertising departments or firms; for fundamental information in regard to the trend of business and business conditions, upon commercial publications, statistical service organizations and Government reports. Schools of business administration are also beginning to offer research service.

“During the last ten or fifteen years departments of research have been established in large numbers of concerns, and such departments will soon be and perhaps already are, considered an essential part of the equipment of a big business. The same cannot be said of business of small and moderate size. For these groups business research is in its infancy. A beginning has been made by some of the associations into which these concerns are organized, but hardly more than a beginning. . . . Co-operation in this work is essential and experience seems clearly to indicate that co-operation through trade organizations is best. . . .

“An excellent method of securing this kind of co-operation was discussed at a meeting of the Association of Collegiate Schools of Business. . . . It was the organization at each one of these schools, or at least at the best developed and equipped of them, of a Bureau of Business Research; the establishment of vital connections between these bureaus and the trade organizations of the country; the division of the field between these bureaus in such a manner as to avoid duplication; and the making of the results of each available to all and to the co-operating trade organizations and the business men of the country. . . .

“At least three such bureaus have already been organized and are in active operation, namely at Harvard University, Northwest-

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<sup>1</sup>The Amos Tuck School of Administration and Finance, Bulletin, 1920-1921.

ern University at Evanston and at the University of Washington. The University of Wisconsin is seriously considering the establishment of such a bureau in its School of Commerce."<sup>1</sup>

## MANUFACTURING

Scientific research and manufacturing have been closely associated; there is, in addition, a marked movement for industrial research with the purpose of giving management in production and distribution a basis of more intelligent control.<sup>2</sup> It has been variously estimated that production runs from 35% to 85% of what might be the normal output; definite knowledge of all the related facts is essential to the improvement of this rate. The complexity of modern industrial operations is so great that executives must increasingly expect masses of figures to be presented in summary form for ready comprehension, especially those representing trends and comparisons over a period of time. It is essential that the management should know definitely the progress the business is making in each department in efficiency of production and distribution, how this progress relates to that of other industries and why.

There are four phases of industry which involve statistics, closely related and often unified:

(1) Scientific research, in which data are compiled in research and control laboratories pertaining to the results of experiments by engineers and scientists designed to control or improve the quality of the product or the processes of manufacturing it; curves are plotted to summarize results.

(2) Statistical study as basis of policy of matters pertaining to plant organization and administration. A form of organization for statistical control has been described, for example, in which "the chief statistician becomes responsible for graphical and other analyses of the primary accounts, for their interpretation in terms of conditions revealed by the operating statistics and for close co-operation with the general auditor in respect to the combined efficiency of accounts and statistics both as to the cost of handling and as to the accuracy and completeness with which the facts relating to the business are set forth. In addition, the chief statistician

<sup>1</sup> Wm. A. Scott, *Business Research, A Necessity Born of Competition*, in *Banker-Manufacturer*, February, 1921.

<sup>2</sup> For a bibliography of industrial research see *A Reading List on Scientific and Industrial Research and the Service of the Chemist to Industry*, pp. 17-35, National Research Council, Washington, 1920. Printed also in *Special Libraries*, January, 1920.

will be charged with the duty of abstracting and boiling down, graphically and otherwise, for the general use of the executives, much of the information contained in the detailed reports made to the operating vice-president. A further duty will be that of the development of statistical methods and practices and of checking the operating statistics periodically in co-operation with the departmental staffs to make certain that all important features of the company's business are adequately analyzed. . . . Proper statistical control involves the preparation of at least a rough annual financial budget; . . . it should be thoroughly checked against long term trends indicated by the accounts and operating statistics, which trends must be adjusted in turn to allow for any expected variations from normal business activity during the year involved. . . .

"A final feature of statistical control is the long term projection of sales and revenues, expenses, construction expenditures and financing. Such projections may cover five or ten year periods and should be revised annually. If used with discretion and with a proper recognition of their necessary inaccuracy beyond the first two or three years covered, they form a valuable guide in connection with the long term financing and development of any enterprise."<sup>1</sup>

(3) Investigations pertaining to the problems connected with the employment, efficiency, remuneration and welfare of labor. Analyses of production records, time-keeping and pay-roll records, accident records, employe benefit records, wages and cost of living, etc., are all of increasingly recognized importance in personnel administration. Where mental or trade tests are used, the records are analyzed and compared.

(4) Trade investigations in which data are gathered concerning the market of the particular product, statistical studies are made for judging the rate of business increase and all data regarding sales are organized and analyzed. "A certain manufacturer in the Middle West was interested primarily in breaking into New York markets; research showed him that totally neglected at his own door there lay a larger market, easier to get and likely to prove more profitable than the coveted New York market; research showed another manufacturer that his distribution was far from uniform, another that he was restricting his line to jobbers when the possible sale for his goods was almost confined to those stores which aimed to buy

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<sup>1</sup> M. C. Rorty, Making Statistics Talk, in *Industrial Management*, December, 1920.

direct, another who sold direct that a major portion of the opportunities in his field could be best reached through jobbing channels."<sup>1</sup>

Some time ago the ice cream manufacturers of Chicago undertook a joint plan based on an analytical study of the capacity of Chicago to consume ice cream.<sup>2</sup>

Industrial research is carried on not only in industrial plants but also by contracting and consulting engineers,<sup>3</sup> efficiency experts, and bureaus for industrial research as well as by industrial commissions, arbitration boards and Government departments.

"In the field of production something has already been done toward applying scientific principles to business activities. The whole movement for scientific management has placed an emphasis upon a careful and detailed analysis of each production problem."<sup>4</sup>

"Scientific management, in its broadest aspect, is not merely labor-saving management; it is not even shop management; it is industrial management by the scientific method. It is not limited to cost and production, but extends to methods of distributing and marketing the product, to meeting the changes in character of fashion of the product, to questions of concentration, of expansion, of relocation, of finance, etc."<sup>5</sup>

A woman who is now working on the statistics of number and amount of orders, cost per order, average payroll per order, etc., began as mathematician for the purchasing department of an industry.

A woman with experience in statistical work in a government department was given the opportunity to develop a new position created by a silk manufacturer to make the office function more effectively.

A woman employment manager found a very large part of her work to consist of statistical analyses of turnover made at the request of the management, and considers that the failure of her predecessor was due to her inability to prepare statistical material.

Some additional records of women engaged in statistical work involving industrial problems follow:<sup>6</sup>

<sup>1</sup> C. C. Parlin, *Why and How a Manufacturer Should Make Trade Investigations*, in *Printers Ink*, October 22, 1914.

<sup>2</sup> Cameron McPherson, *Making a "Survey" of Possible Demand and Developing it*, in *Printers Ink*, May 20, 1915.

<sup>3</sup> For example see *Appraisals and Rate Making, Utility Regulation and Rate of Return, and Price Levels in Relation to Value*, Sanderson & Porter.

<sup>4</sup> C. S. Duncan, *Commercial Research*, 1919.

<sup>5</sup> William Kent, *Investigating an Industry*, 1914.

<sup>6</sup> See also page 125.



Position	Duties
Statistical research worker with a firm of consultants and engineers in industrial personnel.	Tabulating mental test records; assisting in wage studies, labor turnover studies, etc.
Statistical clerk in machine manufacturing industry.	Time-keeping and pay-roll work, records of shop men, hospital records, etc. Cost-keeping for the entire establishment.
Research engineer and supervising statistician in a machine manufacturing industry.	Investigating the results of a series of experiments designed to improve the quality of the product and working up fundamental physical laws based upon these results.
Assistant in the department of the safety engineer of an industry, involving personnel relations.	Investigation of housing, thrift, pensions, industrial representation, etc. Recommendations are made on a basis of study of the plant and of customs in other plants.
Assistant to the business director of a newspaper.	General surveys of various departments for improving the plan of organization. Statistical studies and graphic representation of the same.
Statistical clerk in a public utility industry.	Supervision of the statistical work of the benefit fund department; examination, editing and filing of reports; compilation of statistics in all phases of the problem.
Assistant to the head of the statistical department of the managers, financial and operating, of public utility properties.	Analyzing financial reports of subsidiary companies; making special statements, for firm or for public, of particular companies under the management; preparing financial statistics of the firm.

## TRADE

Like the manufacturer, the buyer and seller finds it essential to study definitely the records of his own business. An analysis of inventory, of sales accounts and purchasing records furnishes a basis for adjustments between demand and supply. Of primary importance to the merchant, however, in these adjustments are the more inclusive commercial statistics which give him an adequate understanding of his market. The possibilities in the development

of commercial statistics and their value in putting trade upon a scientific basis are just beginning to be realized. Wholesalers have more fully recognized the value of a superior knowledge of trade conditions and have done much to organize a system of securing reliable market information. The large retailers—in department store, chain-store and mail-order house—have developed scientific records and in some instances research departments. It is the general retailer who has been slower to recognize the value of scientific business practice.<sup>1</sup>

For the department store commercial research has shown such facts as that there is, outside of grocery jobbing centers, a close similarity between the volume of grocery jobbing business and department store business; that 43 per cent of the volume of department store business is conducted by 1,141 stores, each with a business of \$200,000 and up; 47 per cent is conducted by 172,000 stores with a business of \$100,000 and down; that 3 is the minimum number of department stores that makes for the most satisfactory business conditions in any one community; that 200 larger stores buy direct from the manufacturer, all others through jobbers. The department store has certain limits depending upon underlying laws which it must find and study.

"Studies which we have made during the past nine years have convinced us that fundamental economic laws determine opportunities and limitations for jobbing and retailing in every city. The activities of merchants are by no means an inconsequential factor, yet it seems clear that the operation of laws beyond their control are to a considerable extent shaping their destinies. . . .

"Types of stores did not happen by accident—they evolved in conformity with economic law. Department stores, specialty shops, chain-store systems, corner stores, each developed to meet a definite need, each has its opportunities, each its limitations."<sup>2</sup>

The chief of the research department of a mail-order house describes the service of the department:

"A mail-order business draws a good percentage of its money from farmers and country people and this company has always endeavored to keep in close touch with agricultural developments, knowing that prosperity of agriculture means the prosperity of the business.

"It has been my duty to bring before the publicity division and the merchandise managers first hand information in the form of

<sup>1</sup> See C. S. Duncan, *Commercial Research*, 1919.

<sup>2</sup> C. C. Parlin, *Basic Facts of Prosperity* in 1920.

reports, personal interviews, investigations, etc., setting forth the changing viewpoint, attitude, buying power, economic and financial conditions of our customers.

"This company realizes that conditions are changing very rapidly in farm life. Great progress is being made. It is our plan to talk in the language of the farmer customers and show a sympathetic understanding of their problems.

"Our first service has been to render summarized reports covering conditions and outlook on live stock. These reports have been the result of personal investigations and survey of Government and state crop reports.

"In addition, we have gathered certain specific information concerning merchandise, our competitors' values, sales methods of small town merchants, the kind of goods most used, the outlook, quality, etc.

"We have passed upon the agricultural papers as advertising mediums and made special trade analysis reports very similar to that compiled by advertising agencies and others.

"Of late months, we have done a great deal of personal survey work among our customers, in order to draw conclusions concerning the mail-order business."

The manager of a commercial research department in a packing house writes:

"There is a growing feeling among large manufacturing and mercantile concerns, that in order to get complete and substantial service, it is necessary for them to have investigating and planning departments of their own, and that there is a permanent place for such departments. The larger the concern, the greater the need for such a department. But what is the kind of information wanted? What are the features of sales organization and methods that are beginning to demand attention? The answers to these questions indicate in general the function of a commercial research department.

"The science of commercial research has not developed sufficiently as yet to give a very specific answer to these questions. The functions of such a department depend largely, of course, on the nature of the business, and the selling methods in use. In the case of a large business with different departments selling a variety of articles, the functions of the research department are more numerous than in the case of a smaller concern selling a single product. The manufacturer of advertised and branded articles

usually has more need of a research department than the seller of unbranded articles.

"The fundamental question which a commercial research department faces is this: How can we extend the market for our goods? But in order to answer this question, other questions have to be asked. Are we getting the best results from our present selling activities? What are our selling costs? Is our distribution even throughout the country? What share of the business are we getting? Are the salesmen properly trained? Are they paid in the best manner? How often do they report and what do they report? How well do salesmen cover their territories and are these territories laid out scientifically? Could business in certain sections be developed by establishing branch houses carrying stocks of goods? Then there are other questions concerning sales policies and price policies. . . .

"Perhaps the most important service that a commercial research department can perform is the collection of information that can be obtained only by field analyses or market surveys—that is, information that does not exist within the organization in any form, but that has to be gathered from the outside."

Positions in commercial statistics and research are as yet limited, but there is much promise of increased opportunity in the field of trade, in which the need for scientific methods is just beginning to be realized. As in other business organizations, only the larger wholesalers and retailers tend to make provision for their own research; the increasing research service of trade associations, advertising agencies, publishing houses, and business research bureaus is contributing much essential trade information.

There is a growing appreciation of the need of a Federal trade census. "The study of domestic trade in the United States is seriously hindered by the dearth of readily accessible information. To facilitate researches in this field there is a need of a Federal census of market distributors—dealers in raw materials, commission merchants, wholesalers, and retailers."<sup>1</sup>

## BANKING AND FINANCE

In even greater degree than other business organizations banks and investment houses depend in their operation upon current internal statistics—accounts, records of branch offices, records of salesmen, etc. They depend equally upon statistics of the entire financial world and commodity market. Since banks provide credit

<sup>1</sup>Melvin T. Copeland, *Business Statistics*, 1917.

for the production and transportation of commodities, they must know definitely the immediate facts concerning capital, credit, exchanges, prices, domestic and international, stocks and bonds, the relation of prices in stocks to the prices of raw material, savings statistics. They must have equally definite and immediate information in regard to the economic status of basic industries, and marketing conditions.

In discussing the financial statistician at the first meeting of the American Association of Financial Statisticians in 1917, the president of the Association summarized the primary activities of the financial statistician:

"The work of the statistician constitutes a profession, since it is of vast importance as a social service. It demands specialization of effort even to the degree of affecting personal habits. Its primary function is to analyze the demand for capital, and in doing this it requires of the practitioner besides a general education, some familiarity with the principles of economics, of statistical methods, of accounting, of engineering and of the law. The statistician represents one of the functions of the bond house, that of discovering the demands for capital and of weighing the relative merits of these demands."<sup>1</sup>

The following statement as to the use of statistics in buying and selling stocks and bonds is quoted from a business announcement of an investment firm:

"Reliable financial information is of the first importance to the investor. . . . Records and figures in regard to corporations and their securities are available and form an excellent guide for those investors who make commitments on evidences of intrinsic value. Day to day news is apt to mislead those who attempt to gauge the shorter movements on the quotation board. The long price savings, however, are governed by the progress or decline of individual corporations and of national industry.

"The expert statistician investigates and weighs assets, earning power and management. . . . Our statistical department is efficient. We invite you to ask for its service either in advising you on conditions in any industry, or for data on individual stocks and bonds."

Although this is as yet largely an untried field for women, there are various instances in which women have been employed as assist-

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<sup>1</sup> Charles W. Gerstenberg, *The Financial Statistician*: An address delivered before the American Association of Financial Statisticians, May, 1917.

ants in research or statistical departments in banks and investment houses and a very few instances in which women efficiently direct such important departments. The investigations they undertake may be used as bases of policy, for the advice of individual clients or for general public information. In any case it must be accurate and up to the minute. One woman statistician in a bank was recently called upon, for example, to cable from New York a judgment as to the future of the tin market to a firm in Chile. This involved securing, interpreting on the basis of related knowledge and summarizing into cable length the latest data regarding the current conditions surrounding the tin market in London, Singapore and New York.

Another financial statistician writes: "The field of the statistician in the investment house is likely to cover a wide range, embracing practically the entire field of economics as a whole and specializing particularly in such branches as will bear directly on the interests of the firm. It is likely, also, to involve comparative statistics of corporations and securities, leading to the preparation of investment lists and, also, in aiding the firm to judge of the relative values of securities which may be purchased."

Many of the large banks and investment firms issue periodical bulletins which contain summaries of financial news and items of economic importance affecting financial and banking conditions in this country and abroad.

In order to make progress in statistical work in a bank it is necessary not only to know statistical method but also from practical experience to learn to understand banking and how the business of a bank is conducted. There is no department which may give better opportunity to learn all the phases of banking than the statistical department. It is a custom in some banks to train future executives through experience in this department. It depends upon the alertness, observation, application and initiative of the worker whether she will continue in subsidiary work or develop her experience upon so broad a basis that her judgment becomes increasingly valuable.

A woman working in an investment house has recently issued a brokers' hand-book containing market range, par, capitalization and dividends of securities on the New York curb market. Further illustrations of women's work in financial organizations follow:<sup>1</sup>

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<sup>1</sup> See also page 126.

Position	Duties
Statistical and income tax clerk in a bank.	In charge of all income tax matters, also assistant in collecting and organizing statistical material, dealing with earnings, balance sheets and general corporate assets.
Statistician in economic research in a bank.	Analysis of the economic status of various basic industries; the writing of comprehensive reports with graphs.
Statistician in the office of a broker.	Keeping graphical data on stocks of interest to the employer, and charts showing the relation of prices in stocks to the prices of the raw commodity.
Financial statistician in a bond house, under the supervision of the publicity department.	Collecting information and compiling statistics about various stocks and bond issues; carrying the responsibility for the interpretation of statistical data and for finished reports.
Statistician in an investment securities house.	Compiling records of five hundred or more salesmen and of fifty branch offices and managers, from daily, weekly and monthly reports; recording production and cost of operation with charts; working out averages and bonus lists for the accounting department.

## INSURANCE

In insurance the use of statistics has been very highly developed. Vital statistics, statistics of accidents, statistics of past experience in insurance, internal statistics of investments, cost of operation, etc., are all essential as basic material for the actuary in solving the problems, involving the combined effect of compound interest and of probability, that are concerned in calculating adequate rates of premium and of reserves for insurance companies.

A woman with wide experience in this field has written: "In general the science of insurance, of whatever sort, is based upon the law of averages. In life insurance the mortality table is used as a basis for determining the average death rate under given circumstances. Fire and marine insurance depend upon the fact that the events insured against will, on an average, produce certain losses in definite periods of time. The theory of casualty insurance is based upon the same principle. There are very distinct differences between the methods of treatment to be applied in different types of insurance because of the diverse way in which this

law of averages applies in varying contingencies. While the fundamental principle in all insurance is that of averages, yet in no case is that law taken as final, but such adjustments must be devised as will insure a fair consideration of the individual."

Actuarial work involves the use of a restricted kind of statistics and is primarily mathematical. The Actuarial Society of America has outlined a standard course of preparation<sup>1</sup> for this work, which requires five years to complete while working in insurance offices. This recommended preparation includes work in statistical methods as applied in making mortality investigations and in constructing and graduating mortality tables.

Several large life insurance companies have developed in recent years a separate statistical department whose scope is more broadly informational and provides a background of authoritative information as a basis for determining policy in all insurance matters. Since whatever bears on human longevity is of interest to insurance, investigations are made in this department, of diseases, all constructive health matters, occupations as affecting health and longevity, the influence of race and place of residence on the length of life, and the total experience of insurance companies in dealing with these matters. It is not surprising, therefore, to find an insurance statistician writing a book on cancer, co-operating with public health agencies, and addressing medical societies as well as associations of experts in economics. The annual record of deaths among the insured of the company is submitted to this department and a careful study is made of its indications, followed by complete investigations of all matters related to any new tendencies discovered in this record. The normal premium rates are determined in the actuarial department, but companies in which there is a statistical department refer to it all cases in which there arises the question of subnormal rates because of occupation, race or nationality, or residence. In one large company there are approximately five hundred such instances each year, in which the applicant for insurance contemplates a journey or change of residence, or represents an unusual race or nationality or occupation. It is only on a basis of complete information, geographical, occupational, and ethnographical, that recommendations for such rates can be intelligently made.

A few records of women working with statistics of concern to insurance are the following:<sup>2</sup>

<sup>1</sup> Actuarial Society of America, Recommendations of the Educational Committee Published by the Society, 1918.

<sup>2</sup> See also page 126.



**Position**

Statistician in a casualty insurance company.

Statistical clerk in a workmen's compensation service bureau.

Clerk in a state insurance department.

**Duties**

In charge of all accident analysis, seeking causes for the chief accidents with a view to preventing them; keeping watch for safety engineer on accident experience of member companies; keeping statistics of the investments of the company; making statements of losses for different classes of casualty insurance.

Solving problems of rate-making principally for workmen's compensation insurance; compiling the experience of various companies as data for the basis of rate-making.

Figuring ratios by means of the millionaire machine and slide rule; arranging experience sheets of insurance companies into groups and making tables of the results; finding differentials and arranging tables for purposes of comparison; finding averages; tabulating results for use in making and approving of rates used by insurance companies for various classes of workmen's compensation insurance risks.

**ACCOUNTING**

Accounting and auditing firms and accounting departments within business organizations, have largely expanded their work from bookkeeping and finding errors, to a study of the trend of the facts which their figures represent, and are becoming important organizations for business advice and control. The accountant may be a business investigator whose reports include a survey of the business with recommendations based on an analysis and interpretation of the accounting records. These records are, of course, limited to internal business facts, but the statistical analysis of accounting records brings out important comparisons such as the relation of sales to advertising, the relation of profits to fluctuations of raw material, the relation of profit to general business fluctuation. The accountant must be able to present such material in chart form.

A recent advertisement of a firm of certified accountants featured the service offered by the firm in the preparation of graphic charts or the establishment of a competent department of graphics within a business organization. "Graphic charts are moving pic-

ture stories of business activity. They are figures illustrated. They picture the vital facts of your business as those facts are revealed by figures—compare them, weigh them, measure them. . . . The value of your graphic charts depends on the just application of correct figures and the use of correct chart forms. Perfect accounting must be their base.”

The importance of the accountant's records as statistical data is evident from the movement for standard systems of cost accounting in order that comparisons may be made from a common basis. The statistics for American railroad earnings and expenditures have become far more useful since the Interstate Commerce Commission prescribed standard accounting methods. Several trade associations have prepared uniform accounting systems for their members so that the data for the particular trade may be comparable. The Harvard Bureau of Business Research in its investigations of a number of retail and wholesale trades, has found it necessary in each case, because of variations in bookkeeping methods, to prepare a uniform accounting system as a means for securing comparable figures.

The following excerpts from letters from certified public accountants illustrate the relation of statistical methods to accounting:

“We would have no place on our staff for one who is merely a statistician. A knowledge of statistical and graphic methods is, however, a distinct advantage to an accountant, although there are many excellent accountants who would not pretend to qualify as expert statisticians. A cost accountant should be well versed in graphic methods. Personally, I find them of great use in almost any study of figures.

“The work of the certified public accountant is fundamentally that of auditing and certifying to the correctness of accounting statements. It is not often that we are called on to go into matters of statistical compilation. There is, however, a real place in business for the statistician or statistical accountant, and I know of many such an employe. In most cases, however, in which I know of this position it is being filled by someone who has come up from the inside and has a pretty full knowledge of the method of handling the accounts and the details of the business. Often this work is done by someone who is called ‘Cost Clerk’ or ‘Cost Accountant,’ but whose real work is the compilation of statistics from the accounts and the presentation of those in statistical tables which are termed ‘Cost Accounts’ (which they may or which they may not actually be). Often a concern has ‘sales statistics’ or ‘sales statements’ prepared by a clerk with or without title, who is, in fact,

a statistical accountant. As indicated above, I think in most cases the position has been rather a growth and the employe has come through process of natural selection, rather than through deliberate intention to create a job as statistical accountant and to employ a statistical accountant to fill it.

"Undoubtedly there are those who have particular aptitude for statistics and can render very valuable service in business positions, but I think in most cases the primary requirement in business statistics is that they should be compiled by someone who has had considerable experience in that particular business line so that he can have the ability properly to compile and interpret the statistics. Furthermore, it is quite essential that anyone taking up this work should understand the administrative organization and the personality of the managers to whom the statistics are to come in order that he may furnish to them the facts they are interested in and can give such facts in a form that they can readily understand and of which they can make some practical use."

"Most of our men at one time or another do statistical work, although we do not classify any of them as statisticians. Modern methods in accountancy make extensive use of statistics and graphs in presentation. The practice is steadily increasing. Some business organizations have accountants who devote their attention to statistics and are sometimes called statistical accountants."

"Statistics have been used in accounting for some time and are being used more and more every day in direct proportion to the expansion in size of commercial enterprises. In large business enterprises the multitude of the figures and facts which are presented to executives from time to time are incapable of accurate understanding without the use of well ordered tabulations, graphs and charts. It is in this connection that accounting relies upon the principles of statistics. Insurance, railroad, manufacturing and mercantile concerns have come to rely very heavily upon statistics for a proper interpretation of accounting facts and for the setting of ratios and standards.

"We do not at present employ any statisticians, as such, on our staff, although the accountants employed thereon are expected to be well grounded in the principles of statistics for the presentation of facts and figures in financial reports and in the devising of systems, especially factory cost systems."

## ADVERTISING

In the rapid evolution of the advertising business the collecting and analyzing of basic facts have become a recognized necessity, not only for the purpose of intelligent copy writing and general advertising plan, but also to meet the demands of employers for reliable business advice.<sup>1</sup>

"The good advertising agent is a high grade business adviser; he offers the customers ideas and practical aid, born of experience, together with a real concern as to the customer's success. Advertising is today but one feature of the work of a real agency."

Sales record curves keep the advertising manager of a business informed as to what he is doing. Research is the safe method for testing demand for products advertised and for determining each year the amount of advertising appropriation to be made. The following incident illustrates concretely the relation of facts to advertising and to market and sales problems:

"When someone recently informed the president of a large soap concern that 664,000 pounds of laundry soap had been sold in the State of Connecticut in one week it set him thinking. Like other executives he had never stopped to analyze closely the statistics of his own industry—or, what is more likely, had never seen any or made any effort to compile them. He naturally asked whether this amount was above or below the average. The next intensely interesting question was, what proportion of the total had his company sold? When his accountants had matched against the total state figures the firm's sales figures, it 'made him sick.' . . .

"Resentment against his own poor showing in Connecticut made this manufacturer wonder what the normal per capita consumption of laundry soap was. Taking 664,000 pounds of laundry soap for Connecticut and dividing it by the population (1914), 1,202,000, he found that the per capita consumption was .55 of a pound per week—more than 10 per cent above the average for the United States.

"This incident so interested the manufacturer that he determined to do the difficult work of making local analyses of the consumption of laundry soap, covering the entire country, state by state, and dividing the population by grades of town. . . .

"As the consumer investigations progressed, variations innumerable in local conditions were disclosed, many vitally affecting the success of an advertising campaign which would not be brought

<sup>1</sup> See Paul Terry Cherington, *The Advertising Book*, 1916, Chap. IX.

<sup>2</sup> Richard J. Walsh, *Selling Forces*, 1913.

to the firm's attention ordinarily. The differences in local pay-days, average income, nationality, predominating occupations, standard of living, and many other facts useful in determining the fertility of a given section—all these factors are charted on a huge wall map in the sales manager's office by means of confidential symbols. . . . This method gradually builds up a complete statistical analysis of the laundry soap industry, and brings the once gambling occupation of soap selling closer to the ideal of the insurance business where the averages, etc., are accurately known."<sup>1</sup>

A woman who is head of the department of statistics and investigation in an important advertising agency has described the variety of facts upon which an intelligent advertising program is planned. The character of the product and its rank among its competitors must be determined. The range and limitation of the probable audience for the advertising of any one product as well as the content of the copy is established according to the character of the product. Soap which costs twenty-five cents a cake may be of quite superior grade but will not appeal to many mothers with several children to keep clean. The audience to address in advertising one such soap was determined as limited to the unmarried woman eighteen to thirty-five years old. What they read is the next question, and what medium will be most effective in reaching the audience determined, periodical or poster or some other form. All this involves a study of the results of past experience and the keeping of various records.

The advertising agency must know the business situation of the client as well as the character of his product in planning the kind of advertising contract which will meet his needs; it must study also the effects of its service upon his business. This often involves an analysis of accounts.

A woman who is manager of the department of survey and analysis in a direct mail advertising agency prepares some copy and supervises some of the printing as well as carrying complete responsibility for gathering and analyzing facts preparatory to an intelligent campaign.

Statistics graphically presented are increasingly used in illustrating advertising copy. "The tendency in current technical advertising seems to be toward the presentation of a greater amount of definite quantitative information. Evidence in the form of statistics is being presented to back up the claims of the manufacturer. An examination of the advertising of recent months indicates that

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<sup>1</sup> John Wenzel, How to Study the "Per Capita," in *Advertising and Selling*, January, 1915.

fully 90 per cent of the advertisements carry some sort of statistical information. To be sure, this is often incidental but often, too, it forms the main appeal. Sales figures, performance records, increases in production, the time and labor that can be saved, initial cost figures and the ultimate savings or one of a thousand other measurable facts can be found in almost every technical advertisement. A very definite move is apparently being made to lead the buying public to think in quantitative terms about the technical product."<sup>1</sup>

Publishing companies with a large clientele of advertisers have in a few instances organized commercial research departments to study "the general trend of industrial conditions, the more specific trend of a particular industry, and the trend of an individual concern in bringing its manufacturing and selling methods into harmony with the evolution of its particular industry." Such departments are not only of essential value to the advertising organization of the publishing house, but offer their information service freely to all clients.

#### TRADE ASSOCIATIONS

In this day of organization every industry tends to seek its kind in trade associations with a resulting complexity of group activity in such associations. Not only are there distinct trade associations such as the National Association of Cotton Manufacturers, the Silk Association of America, the Writing Paper Manufacturers' Association, the American Bankers' Association, the National Association of Credit Men, Wholesale Dry Goods Association; there are also organizations of such associations like the National Industrial Conference Board; less specific organizations such as chambers of commerce, city, state and national; merchants' associations; boards of trade; and the various trade unions and workers' organizations. One of the most important functions a trade association can perform is to compile for its constituent members such data as exist among them in unorganized form, with related information which is essential to progressive business policies and to an understanding of the trade as a whole, but which it would be difficult, costly and impracticable for individual members other than the largest industries to secure for themselves.

There is a growing tendency to establish a statistical, research, or information department at the headquarters of a trade associa-

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<sup>1</sup> A. H. Richardson, *Graphic Methods in Technical Advertising*, in *Industrial Management*, April, 1921.

tion to gather and dispense information important to the trade. Many such departments are already proving very useful; suggestions as to the character of their work follow:

"This association maintains a statistical bureau which consists of four or five statisticians, some of them trained and others junior clerks. The statistics compiled are mostly in regard to the world's raw silk production, exports, imports, etc. At present we are also working on figures for the manufactured article."

"We maintain a research department. . . . Our work so far has consisted largely in drawing up questionnaires which go to members of our association and interpreting the results. The research work of the association is of comparatively recent origin and is in the process of development. We have in the past year obtained information and figures on labor efficiency and on general business conditions, particularly on collections and on sales."

A woman statistician has recently been charged with building up a research department in an important trade organization. In another instance the statistician in a trade association describes her work as consisting primarily of collecting statistics of all kinds from members; these she analyzes, summarizes in tables or graphic form and returns the results to the members. With similar method but quite different content an assistant in the statistical department of a lumber association compiles lumber statistics and gets out daily and weekly reports to the members of the association.

The American Electric Railway Association has summarized the work of its statistical department in its monthly magazine.<sup>1</sup>

"The Statistical Department has on hand and is constantly preparing comprehensive and up-to-date statistics showing the condition of electric railway companies in every phase of operation. This includes:

(a) A complete statement by months of financial and operating statistics of companies, together with an analysis and comparison on various unit bases briefly summarized to show the general situation and tendency.

(b) Fares, rate increases, and applications for increased fares.

(c) The labor situation, including wage rates, summary of labor conditions, analysis of labor contracts, and the prospective demands of employees.

(d) An information service, showing the latest developments with respect to franchises, fares, wages, municipal requirements, and practices and operating methods adopted.

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<sup>1</sup> Aera, August, 1920.

(e) A complete technical and engineering library equipped to furnish information on the methods and practices of companies as to every phase of construction and operation. A clipping service from engineering periodicals, as well as questionnaires collecting information directly from companies, is maintained."

The National Lumber Manufacturers' Association, made up in turn of the California Redwood Association, California White and Sugar Pine Manufacturers' Association, Georgia Florida Saw Mill Association, Michigan Hardwood Manufacturers' Association, North Carolina Pine Association, Northern Hemlock and Hardwood Manufacturers' Association, Northern Pine Manufacturers' Association, Southern Cypress Manufacturers' Association, Southern Pine Association, West Coast Lumbermen's Association, Western Forestry and Conservation Association, and Western Pine Manufacturers' Association, describes its functions as being:

"To study the forestry problems of the nation. To increase efficiency in the manufacture and distribution of lumber. To eliminate waste in logging and milling. To promote the proper utilization of all lumber products. To aid in developing by-products to utilize the largest possible percentage of every piece of timber."

This Association publishes a monthly bulletin of information about the lumber industry and provides a weekly statistical barometer giving current information about changes in supply and demand and the current production and shipments of timber.

The year-book of city boards of trade may contain regularly a current statistical summary of the city's resources, population, industry and government.

The Chamber of Commerce of the United States, through its Foreign Commerce Department, publishes quarterly and yearly reports of the world trade of the United States, selected and arranged so as to make possible comparisons presenting the real national significance to individual industries of the export and import business of the country. A glance at the report for 1920 reveals, for example, that Cuba ranked first in that year as a source of supply for our imports and that from Mexico, ranking ninth, we imported over a hundred and eighty million dollars' worth of supplies; that imports have made considerably greater gain than exports, reducing the excess of exports over imports by 27%. The importance of the exports of coal is appreciated when it is realized that of the tonnage of all commodities shown, coal and coke constitute 57% and rank third in value among articles exported.



## PERIODICALS

As has already been stated, many banks publish periodicals with frequent statistical material. One woman who reported for this study is editor of a bank journal for which she compiles and edits financial statistics. Another makes special investigations in foreign trade for a similar journal; for instance, she recently compiled complete information on the production, manufacture, consumption and uses of Quebracho wood, with statistics of imports into the United States over a number of years.

It has been estimated that there are three thousand trade journals in the United States. There are, for instance, at least a dozen trade journals dealing with the iron and steel business and probably as many concerned with oil. Practically every line of goods with more than local importance has its trade journal.<sup>1</sup> While some of these periodicals are devoted chiefly to current news of the trade many publish technical information and considerable statistical material. This is in some instances prepared by members of the staff, in others by trade associations, or by individual contributors.

From a publishing house which publishes a number of trade journals comes the following statement:

"In our organization we have statistical editors, but on many of our papers the work of securing the statistics for our readers is part of the duty of some member of the editorial staff who is engaged on other work as well. In the same way the clerical work involved is taken care of by clerks who have other duties to perform in addition to this. Much of the statistical information secured comes in the form of answers to questionnaires."

The following quotations are from two leading trade journals independently published:

"The statistics which we gather each month are prepared by members of our staff. Other statistical work on our publication is likewise done by our regular staff. Our experience leads us to believe that such work can be more intelligently done, and more profitably for us, by those who have full knowledge of the bearings of things in the trade we represent."

"We receive much of our statistical matter already prepared in the form in which it appears (except for necessary editorial changes), and such other matter as we make use of is prepared by the editors and editorial staff, who are familiar with the statistics

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<sup>1</sup>For a list of trade and technical papers see Advertising and Selling, November, 1917.

and statistical requirements of the industry through their editorial training. In respect to the last mentioned, it might be well to call to your attention that there are few thoroughly trained editorial or reportorial workers on the trade press (and likewise to a large extent on the daily press) who are not required by virtue of their duties to have a good working knowledge of the preparation and handling of statistical matter."

Commercial journals like Bradstreets, The Annalist, Dun's Review, maintain standard price indices with other statistical "measures of movements" and financial and commercial reports and comparisons. The following statements from two such journals are suggestive of the kind of opportunity they offer in statistical work:

"The statistical work of the Journal is not localized to such an extent as to render easy an answer to the question, how many persons are engaged in it. We gather directly data of various kinds from many persons over a wide extent of territory, securing some also from other departments of this company. The work of assembling and interpreting the data gathered is mainly done by comparatively few people, though their labors are not confined to that work exclusively.

"Speaking generally, the statistical work we do requires an adequate mathematical equipment and experience, a knowledge of the general facts, financial, economic, industrial, commercial or other, relative to the subject under investigation, and, it may be added, particularly in the higher ranges of the work, a certain acquaintance with statistical science and method."

"Most of the so-called statistical work is simply the compilation into weekly records of the daily stock market reports. In this work four persons are engaged. Among them they also compute the index of the food cost of living. The more strictly statistical work is performed by one of the members of the staff, who continues the business index line from week to week. This last is pure statistical work and requires an advanced knowledge of mathematics as well as of statistical methods. In all, five persons are thus engaged in what you might call statistical work, although in the case of only one is the work of a sort which requires either a very profound mathematical knowledge or considerable familiarity with the mechanics of statistics."

Financial journals like the Financial World and the Wall Street Journal are also to be included in the group of commercial periodicals. Some financial journals maintain a statistical department, one of whose functions is to provide for subscribers information and personal advice on securities.

A group of journals which publish important contributed statistical material is made up of the professional statistical and economic journals; the Quarterly Publication of the American Statistical Association, the Publication of the Royal Statistical Society, The American Economic Review, The Economic Journal, The Journal of Political Economy, the Political Science Quarterly, the Quarterly Journal of Economics.

Some newspapers maintain statistical departments in which charts and statistical material are prepared covering their own operations as a business. In some cases such a department keeps records of the advertising lineage used by various classes of business in all the local newspapers and these papers are subscribers to the service; on the basis of these facts a great deal of promotional advertising is developed.

A magazine may offer occasional opportunities to arrange material for graphic presentation in tables, maps or charts; this is usually piece work and cannot be counted upon definitely or regularly.

Reference has already been made<sup>1</sup> to the commercial research departments established by some publishers of periodicals for the advantage of their advertising departments and for service to their advertising clients.

### STATISTICAL SERVICE ORGANIZATIONS

There have recently come into existence statistical organizations, economic research bureaus and business research bureaus whose functions are to analyze past and present economic conditions, to forecast the future trend of business in its various aspects,<sup>2</sup> and describe fundamental conditions upon which concrete plans for action may be based. This material is published at regular intervals for the clients of the organization.

It has long been known in a general way that times of prosperity and times of depression in business recur with more or less regularity. But it is only through recent development of statistical and economic analysis that it is possible to record the fluctuations in business activity in such a way as to project movements into the immediate future. Business forecasts or barometers have been compared to the pressure gauge on steam engines; they are of value for control not only to finance and industry, but useful

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<sup>1</sup> See page 81.

<sup>2</sup> See Warren M. Persons, Construction of a Business Barometer Based upon Annual Data, The American Economic Review, December, 1916. Roger W. Babson, Business Barometers, 1913.

also in a large social sense for the warning they give of coming periods of unemployment.

A committee on economic research which offers to business men its statistical service gives a summarized account of its work as follows:

"The most important feature of the service is our Index which is published regularly in our bi-weekly Advance Letter on General Business Conditions. Even under the abnormal conditions which have prevailed since the armistice, this Index has correctly forecasted wholesale commodity price movements and general business activity and has created widespread favorable comment in business circles.

"No forecast of general business conditions can safely be made without taking into account the recent changes in our economic organization. For instance, any forecast at the present time in order to inspire confidence or even command respect must allow for the changes in our banking system since 1915, the change from a debtor to a creditor nation, the foreign trade situation of the United States, the destruction and shortage of materials as a result of the war, etc. Accordingly we supplement the forecasts based on our Index by economic analyses which are published regularly in the Monthly Review. The Review also includes our Index and a complete survey of general business conditions based thereon. The more extensive studies are published in supplements several times a year."

A statistical organization of similar purpose prepares reports designed to give in brief form to merchants, bankers and investors carefully collected and condensed facts about business and finance. These reports are divided into eight features—a weekly barometer letter; a semi-monthly speculative bulletin, a monthly desk sheet indicating the fundamental condition of American business; a semi-monthly investment bulletin; a semi-monthly mercantile bulletin and map (advice to sellers); a semi-monthly commodity bulletin (advice to buyers); a semi-monthly foreign trade bulletin; a semi-monthly labor bulletin.

The bureaus of business research established by schools of business administration have already been referred to<sup>1</sup> with their possibilities of extensive co-operation with trade associations and business men. The catalogue statement concerning one of these bureaus may be quoted:

"The need of more facts regarding every-day business methods and problems was apparent as soon as the graduate school of busi-

<sup>1</sup> See page 64.

ness administration was established. There were several fields, such as marketing for example, to which little scientific attention had been given. Only scanty information was available regarding the methods by which many types of business were managed.

"The fields of study were so large that organized research seemed essential. Consequently, in 1911 the bureau of business research was established. The primary purpose of this bureau is to gather information regarding typical every-day business methods and problems as an aid to instruction in the school. The results of the investigations of the bureau are made available not only to the students of the school but also to the business men who assist in this work by furnishing reports on their own business. A large number of merchants and manufacturers have made immediate practical use of the bulletins issued by the bureau."

In statistical organizations and in bureaus for economic or business research women are found rendering good service and gaining valuable experience in statistical work; a few illustrative positions are these:<sup>1</sup>

Position	Duties
Assistant to head of labor department.	Advisory work based on statistical data.
Assistant head of computing department.	Collecting data and applying the necessary mathematical operations for statistical study; preliminary drafting in the study and forecast of business conditions.
Head of computing department.	Receiving all orders for computing jobs and planning and verifying the work.
Research worker.	Analyzing and interpreting data, preparing tables, supervising the printing of reports on industrial matters.
Associate director.	Organizing investigations and carrying them through to completion; or outlining surveys, preparing schedules, inaugurating field work and assembling data, appraising material and preparing reports for print. Developing equitable wage bases, giving counsel on industrial and social problems. Technical reports on economic and sociological subjects, or popular reports on such subjects, or reports combining both methods.

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<sup>1</sup> See also page 127.

## EDUCATION

It is only in the last twenty years that experimental and statistical methods have been applied in matters of education; during these years, however, practically every phase of school administration and pedagogy has been attacked with quantitative methods of inquiry. Scientific study of such matters as the distribution of pupils in the various grades according to relative ages, their rates of progress through the grades, the methods of rating pupils' achievement and elimination from school, has made for new principles of school administration.

Psychologists are making fundamental contributions to education in statistical analyses of learning processes, the influence of training in one field on capacity in another field, the problems of mental inheritance, mental work and mental fatigue, and in producing scales and methods for the measurement of ability and of the rate, amount and permanence of improvement.

Psychologists and school administrators are both attacking the problem of the curriculum. What are the minimum essentials? What is the best organization of subject matter? Are individual text-books constructed in accordance with the principles governing learning processes? These are some of the questions which are being quantitatively analyzed.<sup>1</sup>

Much of this educational and psychological research is done in university departments of education, where there is a limited opportunity for employment as statistical assistant to the department members conducting research.

State and city boards of education maintain statistical divisions, as well as the United States Bureau of Education and the Federal Board for Vocational Education, whose work has already been noted.<sup>2</sup> These departments compile and in some cases analyze for the administration school data such as census and attendance records, promotions, retardations, school mortality, health reports, tests of efficiency, school finances, reports of vocational work under federal co-operation.

There are also educational associations, national, state and local, and private foundations and organizations devoted to the advancement of education which conduct important educational and psychological research. The number of bureaus for educational experimentation is growing; statistical departments are inevitably included in such bureaus.

<sup>1</sup> For a complete discussion of this matter, with full bibliography, see Harold O. Rugg, *Statistical Methods Applied to Education*, 1917.

<sup>2</sup> See pages 48, 60.

A limited number of schools employ trained psychologists to apply tests of intelligence and ability. All psychologists entrusted with such responsibility should have adequate training in statistics for the scientific analysis of the results obtained from mental measurements.<sup>1</sup>

There is a slowly increasing opportunity for teaching statistics and for statistical research in college departments of economics, sociology, mathematics and education, and in schools of business and schools of social work. Occasionally there is an opening for laboratory supervision in connection with such a course; the individual problems undertaken by students, with the statistical methods involved, come under the immediate direction of such a supervisor.

Of the twelve women in educational work who reported for this study one is statistician in the division of educational measurements in a state department of education, four are teaching statistics, one is assistant in a laboratory, five are engaged in educational research in organizations devoted to that purpose, one is compiling statistics in a city school system. The following are outlines of several such positions.<sup>2</sup>

Position	Duties
Head of department of social research in a school of social work.	Giving class instruction in statistical methods, including supervision of practical work; planning and supervising research work.
Teacher of economics.	Giving an advanced course in statistics in the department of economics of a college.
Statistical clerk in a board of education.	Getting statistics on expenditures of the city for educational purposes; coding pay-rolls, punching information on cards, tabulating and assorting.
Research worker in a foundation with a department of education.	Tabulating results of tests and in some cases scoring or establishing methods for scoring new tests: finding averages, medians, modes, co-efficients of correlation and plotting curves.
Supervisor of statistical work and filing in a foundation interested in education.	Making graphs and charts from given data.

<sup>1</sup>See Edward L. Thorndike, *An Introduction to the Theory of Mental and Social Measurements*, 1904.

<sup>2</sup>See also page 128.

## SOCIAL WORK

"Disinterested examination of contemporary social facts is rare. Only in recent years has the study of social conditions begun to be scientific instead of sentimental. The very complexity of causation which lies back of social problems has often discouraged painstaking analysis and defied systematic investigation. Prejudice and superstition still hamper and frequently prevent an impartial examination of things as they are."<sup>1</sup>

The more efficient organizations for social work are, however, recognizing the necessity for a scientific study of social facts both in planning their program of work and in measuring the progress made. Only the larger social agencies such as the American Red Cross, the National Association for the Study and Prevention of Tuberculosis, the National Committee for Mental Hygiene (in each of which a woman is in charge of statistics), foundations for research and public boards of health and departments of charities and correction, which have previously been included,<sup>2</sup> regularly employ statisticians and maintain statistical departments. In other social agencies special statistical workers are temporarily employed for special investigations; or the statistical work consists only of compilations of records made by the registrar or the person in charge of records.

The possibilities of the coordination of social agencies for statistics is illustrated by the plan of the Central Statistical Bureau of the Baltimore Alliance. "In January, 1920, the Baltimore Alliance, a federation of fourteen social or charitable agencies in the city of Baltimore, organized a new department of potentially far-reaching importance. It is known as the Central Statistical Bureau, and forms an integral part of the Alliance. The functions of this bureau are (1) to supervise, standardize, and control the permanent statistical records collected by each of the allied agencies; (2) to serve as the final repository of all case and statistical records; (3) on the basis of the critically controlled basic statistical records to carry on scientific investigations of those broad social problems toward the ultimate permanent solution of which the activities of the Alliance are directed."<sup>3</sup> A woman is chief statistician of this bureau.

<sup>1</sup> F. Stuart Chapin, *Field Work and Social Research*, 1920.

<sup>2</sup> See pages 44, 61.

<sup>3</sup> School of Hygiene and Public Health, Johns Hopkins University, Catalogue and Announcement, 1921-22.



It is considered essential for every social worker to have a knowledge of elementary statistics and to be able to use statistical methods in the preparation of reports; a course in statistics is a fundamental part of a social worker's training. While it is frequently true that a social worker develops into a statistician, it seldom happens that a statistician without social work training or experience is employed in this field. As elsewhere a thorough knowledge of the field of work is necessary.

As to opportunities in this field, Miss Sophonisba P. Breckenridge of the University of Chicago has written: "Most of our graduates in social investigation find employment in the Government departments, which, of course, they enter by civil service. They have been especially happy, I think, in the Children's Bureau and in the Bureau of Labor; but some have gone into inspectional work and one or two have organized new forms of service, such as Miss Anne Davis in the Chicago Vocational Bureau, and Miss Letitia Frye in the Visiting Teacher work. My impression is that opportunities of this kind are increasing and that it is becoming increasingly necessary for social case workers to understand the use of statistical methods in the handling of their records and in making special studies on which plans for advances in their work would be based. The trouble is, however, that such demand as does exist is very irregular and intermittent, and we therefore require of all of our students a certain amount of practice work with a social case-work agency, so that the student may not be wholly dependent for employment upon the other field."

The following are examples of women's statistical work for social agencies:<sup>1</sup>

Position	Duties
Editorial worker in the statistical department in a foundation interested in advancing preventive medicine.	Editing of statistical reports sent in from the field to give them printable form and order. Clear, logical statement of the material given in the statistical reports without comment by the editor.
Research secretary in an anti-tuberculosis organization.	Statistical research, including preparation of all schedules, questionnaires, etc., for surveys, study of economic costs, etc.
Statistician for a society of four hundred or more organizations (temporary).	Analyzing, tabulating and presenting and interpreting in a report material on workers' budgets with a view to establishing a salary schedule.

<sup>1</sup> See also page 128.

**Position**

Statistical worker for an organization of day nurseries (temporary).

Statistician in an economic department of a religious and philanthropic organization.

Investigator and statistician in a social research organization.

**Duties**

Gathering data and making tables and interpreting results of a study of mothers who were nursery clients.

Issuing a technical magazine; doing the statistical work for a series of cafeterias; making statistical studies of branch organizations.

In charge of all statistical work, planning methods of compilation, table forms, etc. Planning forms to be used for gathering statistics, planning of tables to be used. Responsible for statistical material in reports published.

## PART V

### Preparation for Statistical Work

**J**UDGMENT, imagination, a wide knowledge of the field of work and a comprehensive knowledge of statistics, with expertness in statistical method, have been designated as characteristics of the statistician. Judgment and imagination depend upon native ability and broad general education and interest. A knowledge of the field in which the statistician works implies also a general education with academic or apprenticeship training or both in such special field. The science and method of statistics may be learned through specific courses in statistics and practical experience in their application.

#### GENERAL EDUCATION

What shall be included in the general education of a student who looks forward to statistical work cannot be too closely outlined. A college course is taken for granted except for the subsidiary clerical positions. It is possible, however, as has been proven in notable instances, with intelligence and devotion, to begin in a clerical position with less preparation, make up the lack through a longer apprenticeship and gain from experience such a comprehensive knowledge of the field as will give background for responsible work.

Statisticians, while insisting that little mathematics is actually used in statistical work, with few exceptions emphasize mathematics, preferably through calculus, with certainly an understanding of logarithms, and if possible accounting, as an essential element in the general education preparatory to statistical work, for the type of thinking involved and for the basic conceptions gained for statistical methods.

Since statistics is fundamentally concerned with social phenomena, work in economics, sociology and history is of the first importance in the general preparation for statistics. At least one foreign language should be acquired, Spanish, French or German, preferably more than one. Training in English composition is valuable for report writing and may make all the difference between clerical and responsible work.

## COURSES IN STATISTICS

### GENERAL EDUCATIONAL ASPECTS

Training in statistics is an important contribution to general education as well as preparation for statistical work. "(Statistical method) is indeed a body of doctrine pre-eminently adapted as preparation and support of a general scientific education. It is closely united to the first bases of human perception and logical thought, and, unlike theoretical logic, does not develop from these ideas an apparently abstract and abstruse system of syllogisms, but shows directly and clearly how these logical connections are turned to account in problems of economic and political life, of a thoroughly practical and indispensable character. In every new explanation it shows in a new form how the slightest error of an idea or smallest logical mistake can render large undertakings useless, and in their consequences misleading and even dangerous for the judgment of important facts of political and social existence.

"The theory of statistics shows also the value and application of logic, and must heighten the interest in critical thought. It leads to a comprehension of the earnest and firm purpose of statistical endeavor, to a consciousness that requires strict truth and love of the truth, that the proper treatment of the conclusions or data, which will not permit or excuse any self-deception, involves a serious responsibility, that may properly be designated as a demand of the public conscience.

"For the youth of all professions, particularly those of official position, the theory of statistics is a very appropriate field of study. When its way is opened more and more among students we may expect a reaction upon political bodies, the press, public opinion, and general culture. We shall then become accustomed to a more critical treatment of statistical questions; ambiguities of conception, of interpretation, and proposals will decrease; statistics will be more exactly applied in their true fields, and, with proofs of their value, the general estimate of them will be higher."<sup>1</sup>

### VOCATIONAL ASPECTS

Expertness in statistical methods has been acquired in various instances by experience alone, but can be more economically gained by beginning with well-planned courses in statistics. These courses would also give some comprehension of

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<sup>1</sup> August Meitzen, *History, Theory and Technique of Statistics*, translated by Roland P. Falkner; American Academy of Political and Social Science, 1891.

statistics as a science, which is valuable at the start for both the future statistician and the user of statistics as incidental to other interests. Such courses would include:

(a) An introduction to statistical literature—to the statistics which are current and the social facts which they indicate.

(b) The practical uses made of statistics, official, social and industrial.

(c) Bases for judging the validity and usefulness of statistics.

(d) An introduction to the theory underlying statistical methods, with practice in the processes of statistical computation and presentation.

(e) Exercise in initiating and carrying through to conclusion, under supervision, problems in the fields of each student's chief interest, such as economics, sociology, psychology, education, biology—in co-operation with the departments concerned.

A laboratory equipped with the computing machines in general use and providing for the actual gathering of statistical data with tabulation, preparation of graphs and diagrams, report writing and general practice is an important asset to any general course in statistics.

Courses in statistical graph and chart making or mechanical drawing are available for those who choose to specialize in these aspects of statistical work. In some instances public high schools provide instruction in statistical computing and drafting.

#### COLLEGE COURSES IN STATISTICS

Work in statistics is elected by students either (1) because of interest in statistics as such, in the quantitative analysis of problems, in research, or (2) because of interest in economics, sociology, psychology, education or science and recognition of the importance of statistics and of accurate methods of thinking in the particular field. For the first group a general course in statistics with a choice among a variety of actual problems to work upon is most satisfactory; such a general course also meets the needs of the second group, while courses in statistics in the departments of interest, with practical work concentrated upon the material of the department, may be equally advantageous. For the arts and science college it is usually impracticable to offer courses in statistics in all departments which they concern; the summary on page 136 indicates the variety of procedure found expedient in those colleges which include statistics in the undergraduate curriculum. The stu-

dent who chooses a course in statistics should recognize the possibilities and limitations of the course as offered by different departments.

*Department of Economics.* It is in the field of economics that statistical methods have been most generally applied, and therefore it is easy to understand that departments of economics have in the largest number of instances been the first to introduce courses in statistics; such courses, as reported in college catalogues, usually center upon a study of the elementary principles of statistics and the application of statistical methods to economic or social and economic phenomena. "A study of the application of statistical methods to social and economic data. Laboratory work illustrates the methods studied and gives practice in the use of computing machines."<sup>1</sup>

Courses in statistics in departments of economics are likely to be broader in subject matter than those given in any other department, with the possible exception of the department of mathematics.

*Department of Sociology.* Courses offered by departments of sociology may be general and planned to "impart a knowledge of the methods and devices used in statistical work which are authoritative and applicable in all departments of scientific investigation" as at the University of North Dakota. They are more likely to be "social investigation; methods of collecting, organizing and interpreting social data" as at the University of Denver, or "studies in immigration and social welfare based on the census and labor reports of the United States" as at Mills College.

*Department of Education.* A course in statistics offered by the department of education even where it is the only course in statistics given in the college, is usually a specialized course, dealing with the application of psychological and statistical methods to concrete school problems. Still more specialized, it deals with the particular problem of measuring mental ability and educational achievement, and includes only a brief survey of elementary statistical methods essential to interpreting the results of mental tests.

In occasional instances the department of education offers first a general course in statistical methods as a prerequisite for a course in mental measurements.

*Department of Psychology.* Courses in departments of psychology treat of statistical methods as applied in experimental psy-

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<sup>1</sup> Mt. Holyoke College Catalogue, 1920-1921.

chology, in mental measurement, in tests of intelligence, character and vocational aptitudes. One such course is described as "a demonstration and working course in statistical methods; theory discussed in connection with practice; the determination and evaluation of measures of central tendency, dispersion, precision, reliability, differences between means and between distributions; seriation and plotting, curve-fitting; correlation. Students provide Davenport's 'Statistical Methods' and a polyphase slide-rule; calculating machines and mathematical tables available. Some knowledge of algebra a prerequisite."<sup>1</sup>

*Department of Mathematics.* A department of mathematics can give courses in statistics without prejudice as to their application, and would therefore seem to be the logical department in which a general course in statistics should be offered. The danger lies in overemphasis of mathematical formulæ; such formulæ are necessary for the statistician but in themselves may become stultifying to the more essential requirement of imagination. Departments of mathematics which offer such courses may co-operate for the laboratory work of the students with various other departments. "The object of this course is to acquaint the student with the principles and methods of statistical work. Methods of collecting, criticizing and arranging data, the use of graphs, histograms and pictograms in presenting statistical relations, and the general manipulation of such material are first studied. The theoretical treatment is supplemented by applied statistics, examples being selected from the widest range possible. A study of errors, probabilities, and kindred topics completes the year. This course is essentially a practical one and meets the needs of the economist, sociologist, biologist, insurance worker, or the investigator in any field requiring the collection and study of statistical data."<sup>2</sup>

"Elements of statistical methods; theory and use of the slide-rule. This course is designed for students majoring in Commerce, Economics, Education, Journalism, Architecture, Mathematics and the natural sciences, who have occasion to compile and interpret statistics. The theory and use of the slide-rule is included for its practical use in shortening the work of computation. The treatment is largely non-mathematical, but students will be benefited by taking a course in advanced algebra beforehand."<sup>3</sup>

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<sup>1</sup> Leland Stanford Junior University, Announcement of Courses, 1921-1922.

<sup>2</sup> Connecticut College Catalogue, 1920-1921.

<sup>3</sup> University of Oregon Catalogue, 1919-1920.

At Wellesley, two courses are offered in the department of mathematics. One is primarily for theory and for those students who wish to use critically the statistics of others; the other is primarily for problem work and is planned for those students who wish to follow a study of the theory with practice in collecting and arranging statistical material.

#### COURSES IN STATISTICS IN VOCATIONAL SCHOOLS

*Schools of Social Work.* Recognizing increasingly the need of basing social theory on scientific social investigation, schools of social work include in their curricula such courses as social statistics, vital statistics, methods of social inquiry, statistical methods.

"Social Statistics.—A course designed to give practical training in the collection and interpretation of statistical material relating to social problems, vital statistics, statistics of pauperism, crime, the defective classes, immigration and unemployment. Methods of presenting and interpreting the material in the case records and files of social organizations will be dealt with."<sup>1</sup>

The courses offered in undergraduate and graduate schools of social work are listed on page 144.

*Schools of Public Health.* Schools of public health require their students to become familiar with vital statistics.

"Vital Statistics.—A course in vital, social and sanitary statistics arranged especially for students who intend to enter the public health service. It will treat of the principles of statistics, population, registration, births and marriages, general death rates, specific death rates, morbidity, causes of death, preparation of tables, plotting, construction of diagrams, graphical display of data, and, in general, the application of statistics to state and municipal problems."<sup>2</sup>

At Johns Hopkins University the work of the department of Biometry and Vital Statistics is intended "to meet the needs of two classes of students (a) those training for work in public health; (b) those intending to specialize in statistical work either as teachers, investigators, or administrators." This department offers courses in advanced statistical theory, the statistical measurement of the effectiveness of public health activities, investigations in biometry and vital statistics with special opportunities for advanced

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<sup>1</sup> University of Chicago, The Graduate School of Social Service Administration, Bulletin, 1920.

<sup>2</sup> School of Public Health, Harvard University and the Massachusetts Institute of Technology, Bulletin, 1920-1921.



students to investigate "the genetic and environmental factors concerned in the etiology and epidemiology of tuberculosis" or "the statistical aspects of the problems of clinical medicine, surgery and pathology," or the broad social problems with which the Baltimore Alliance is concerned.

The various courses in statistics offered by schools of public health are indicated on page 145.

*Business Schools.* Courses in statistics are included in the curricula of many business schools, schools of commerce and in undergraduate and graduate departments of business administration. They are planned for major work in statistics in some instances and also advised for students in such various fields as accounting, advertising, marketing, transportation and public utilities, insurance, real estate and journalism. The character of general courses offered in business schools may be suggested by quoting a description of one of them:

"The object of the course is to study the application of statistical methods and theories to the finding, analysis and presentation of the facts which should be known about a business in order to set standards, to prevent waste, to determine policy and to guide future planning. The elementary principles of theory and method which underlie the gathering, classification and interpretation of collective facts are considered. Practical application of statistical theory is made with reference to the locating and testing of markets; compilation and analysis of sales records; effectiveness and results of advertising; production facts; factory costs; purchasing factors. A brief treatment of the theory of business cycles, the making of index numbers and business barometrics conclude the course. Statistical investigations of concrete business problems are made by students under direction of the instructor."<sup>1</sup>

On page 141 are listed schools of business which offer courses in statistics.

*Schools of Education.* Various courses in educational psychology and educational administration include the elements of statistical method. A number of schools of education offer also more complete courses in statistics. For responsible statistical work in the field of education, graduate courses in education and psychology and training in statistics are fundamental.

"Application of psychological and statistical methods to education. . . . This course aims to prepare advanced students to in-

<sup>1</sup> Boston University, College of Business, Catalogue, 1921.

investigate such problems in education as involve accurate treatment of mental characteristics, and to provide future principals and superintendents of schools with the technical knowledge of statistics which will enable them to use conveniently and profitably the data available in any school system."<sup>1</sup>

Graduate schools of education with courses in statistics are listed on page 146.

*Technical Schools.* Schools of engineering offer courses in graphics, statistical mechanics, the statistical treatment of observations, the theories of average and probability. Some schools of agriculture include courses of statistics in their curricula to familiarize their students with the use of statistics or to instruct them in the application of statistical methods to the scientific problems of agriculture.

"Statistical methods in theoretical physics.—A course of lectures dealing with general aspects and particular applications of the use in physics of statistical methods, which, beginning with the kinetic theory of gases, have gradually extended over a wide range of phenomena, especially those connected with the second law of thermodynamics."<sup>2</sup>

"Agricultural statistics.—A study of the principles involved in the collection, tabulation and interpretation of agricultural statistics. This course is designed for students who expect to do research work."<sup>3</sup>

"Analysis of Statistics.—The special purpose of this course is to acquaint students of agriculture who may have occasion to make use of statistical tables of various sorts, with the modern mathematical methods of treatment. Use is made of farm bulletins, agricultural reports, etc., by means of lectures, readings and recitations."<sup>4</sup>

#### APPRENTICESHIP TRAINING

In some instances large organizations arrange definite training for employes of the statistical department with material drawn from the experience of the organization as a basis for instruction in graphic methods, in the theory of error and similar fundamental phases of statistical work.

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<sup>1</sup> Teachers College, Columbia University, Bulletin, 1920-1921.

<sup>2</sup> Massachusetts Institute of Technology, Bulletin, 1921.

<sup>3</sup> New York State College of Agriculture, Cornell University, Announcement, 1920-1921.

<sup>4</sup> Kansas State Agricultural College, Announcement, 1920-1921.

### GRADUATE WORK

For students who elect their first statistical courses after choosing a field of work and entering upon graduate study, any well planned general course in statistics is an adequate introduction. It will ordinarily be advantageous, however, for the graduate student to secure training in statistics in the department of major work. Advanced work in statistics is usually offered aside from graduate schools and departments of social work, public health, business administration and education, in graduate departments of economics, sociology, psychology or mathematics and deals with research in economics and social statistics, business or industrial statistics with statistical theory, the theory of errors, the method of least squares, or with special statistical problems such as biometry or graphics. Schools offering work in statistics for graduate students are indicated in the lists on pages 137-140.

### ADVICE AS TO TRAINING

Some general comments on training made by statistical workers may be noted:

"The best preparation is a broad general education specializing in what will give the ability to see without being shown, the power of discrimination, and the ability to concentrate."

"Of greatest assistance is the mental grip and adaptability that come from any line of study rightly pursued."

"My whole college training contributed to the broader point of view which has made my present work possible."

"A great help has been foreign residence and travel and contact with people."

"An accounting knowledge has been essential."

"In the statistical work, of course, higher mathematics was valuable, especially the use of logarithms."

"Cataloguing has been valuable, which has taught me to arrange material in the best possible way."

"I have studied many reports, statistically accurate, which failed entirely because the statistician was not grounded in the subject matter of the investigation."

"Courses in statistics are not much use without a professional background of thinking and fact in the given field. . . . Formulae are subordinate, the method of thinking is essential."

"An elementary knowledge of accounting. Any training which will develop broad, open-minded thinking. (This is perhaps the

most essential.) Collateral reading on all kinds of business and financial subjects."

One financial statistician suggests that courses in business statistics are far more valuable to a person who has already had some experience in business than they are to a beginner. She recommends that a girl use them as extension courses in connection with her position, if she can manage to do so. She considers an all round college course a necessity, with special stress on economics and mathematics.

The chief statistician in a state industrial commission writes: "My view, based on considerable practical experience here, is that anyone who proposes to take up statistical work as a permanent occupation should have at least a college education by way of general training and such special training as would be covered by undergraduate courses in economics and statistics. . . . Persons so equipped would be prepared to develop by practical experience in statistical work capacity which would open the way for considerable advancement. Those who hope, however, to make a real profession of such work and to rise to important positions are far more likely to develop capacity which would bring them advancement of that sort if they could have graduate training in economics, sociology and statistics."

A statistician in a large sales agency advises: "The best college training for a person desiring to do statistical work would be the usual course in mathematics and then a good course in economics and statistics with mechanical drawing and charting. In the field of commercial research it is essential that the person in charge of a statistical department be an economist, in order to know what facts and figures to collect and how to interpret them after they are collected and tabulated."

The following letter from Dr. Secrist of Northwestern University School of Commerce suggests various considerations in regard to training:

"The type of training which young women should have in order to prepare them for responsible positions as statisticians seems to me to involve two major considerations. First, fundamental training in statistics and statistical methods in order to observe accurately and to infer logically. The subject content of statistics hinges about observation and inference. I think anyone who is responsible for collecting statistical facts and interpreting them should be trained not only in statistical methods, but in the elements of logic and the fundamentals of economics. If the person is to work in the business field, obviously, training in business economics is also necessary.

"There are comparatively few institutions where satisfactory training may be secured in statistical methods, due primarily to the restricted field covered and to the almost total absence of laboratory facilities. But the technique of statistical application can hardly be satisfactorily acquired where the point of view in the assignment of statistical problems is of the 'make work' type. Wherever data on concrete and live problems can be secured, even though they apply only to a restricted field, an attempt should be made to secure facts and present them in a definite and forceful way. The purposes for which an investigation or a problem is undertaken should unmistakably accompany the observations which are made and the inferences which are drawn. To meet this standard in college laboratories is very difficult outside of a few institutions where there is close contact between the laboratory and business, economic and social conditions.

"Every student should be required to prepare a statement of the purpose for which statistical facts are collected, to map out the sources of information and to construct the schedules, as well as tabulate the data and make the appropriate inferences from them. In reality, this course of duties is closely associated with the results of logic and, of course, presupposes a full and complete knowledge not only of statistical technique, but also of the problems with which the data are associated.

"It is essential that students should have practical experience in field work and in making personal contacts. After all, the routine of schedule drafting, tabulation and presentation can be delegated. The responsibility, however, for undertaking statistical inquiries so as to guarantee against loss of time and money and to insure success can hardly be delegated.

"These are a few of the conditions which seem to me to be important in the training and experience of men as well as women who are to be placed in positions of responsibility. The capacity for forecasting, looking ahead and anticipating difficulties and in planning statistical work is so vital that the training which is given should bear unmistakably upon them."

## CONCLUSIONS

For all statistical work, as much general education as possible is advisable; this cannot be overemphasized. For professional work a college course including if possible mathematics, economics, sociology, history, statistics, foreign languages and English, is taken for granted as preparatory education.

For subsidiary positions a special skill is sufficient technique—stenography, drafting, computing; these may be acquired in special short courses. For progress to professional work, a thorough comprehension of statistics is essential. This may be acquired through experience alone under intelligent supervision, especially if apprenticeship training is provided. Well planned courses in statistics give training which makes it possible to gain at once a more comprehensive knowledge of statistics and training in meth-

ods, and therefore to advance more quickly to responsible work. Such courses may well be elected in college both for general educational value and vocational preparation.

For application in specialized fields, courses in statistics may be pursued as part of the vocational preparation offered by schools for social work, schools of business, education, agriculture, engineering, in extension departments, or in graduate departments of economics, sociology, psychology, education or mathematics. Advanced work in statistics may be elected in such graduate departments.

Experience, with the concrete knowledge of the field of work it brings, is an essential element of preparation.

## PART VI.

### Other Vocational Considerations

#### OPPORTUNITY FOR WOMEN IN STATISTICAL WORK

**T**HE demand for the scientific use of facts in determining practical policies is increasing, as has been indicated. For the person interested in statistics as a vocation there is every reason to expect an expanding future opportunity.

Women have been pre-eminently in demand for the subordinate positions in statistical work: "At lower grade jobs a woman is far better than a man and will do the work far better and more carefully than a man," is typical of employers' comments. The positions of largest responsibility and salary are still chiefly held by men. Where women have advanced it has in most instances been to positions of supervision rather than direction. The reasons for this are not inherent in the character of the work, which in itself, with the possible exception of some kinds of investigation, involves no limitations on the basis of sex. The reasons are rather found in:

(1) The failure of women to understand the professional aspects of this work, so that employers have concluded, "Women do not look to the future—do not make good executives—too temporary—will not work for women—do not want executive jobs or work that is likely to change materially from time to time—like routine work, something steady where they know what is required of them and can tackle it regularly and systematically."

(2) The prevailing acceptance in government and business of the leadership of men, which results in the assumption by men of the responsibility for making progress and taking command and regarding women as assistants, and in the reluctance on the part of women to take the necessary initiative in preparation and in increasingly responsible work. It is therefore true that women must still have more easily discernible qualifications than men, who are more readily accepted on trust.

(3) The instability of women workers because marriage has so frequently interrupted vocational progress. It is doubtful whether women hold individual positions for a shorter time than men remain in similar positions; the difference is more probably in attitude toward the work—temporary rather than professional, with less achievement as the result.

There are, on the other hand, conspicuous instances of women who have attained recognized professional rank in statistics and it is fair to the whole situation to say that the field of statistics is equally open to both men and women and that the work of women who have shown ability to carry responsibility in this field is recognized and rewarded.

It should not be assumed that the subordinate positions may not afford satisfactions or inherent opportunity. An operator of statistical machines can describe her work as "interesting and educational." A statistician in a sales agency describes his assistant: "She combines to an unusual degree speed and accuracy in handling figures. In other words, she is a splendid detail worker and at the same time has initiative and uses her head in detecting errors, avoiding mistakes, etc. For a person of this type there is certainly a fine field in statistical work, for they are hard to find." A woman with a number of years of experience in strictly clerical statistical work testifies, "Personally, statistical work has been very fascinating and agreeable. It requires plenty of good solid plugging but the result, if successful, brings with it a great feeling of satisfaction. For one who is not afraid of hard work and is fond of figures I think statistical work is a good vocation."

It is for the woman with the ability and preparation for more responsible service and for whom her work has become routine that it is a mistake to settle into subordinate work. A woman who has found the chances for responsible work "all that you will assume and show yourself fit to shoulder," admits that often "one is tempted to follow just routine work."

Characteristic comments of women in this field as to the opportunity it offers are:

"About the same as for men except that women are perhaps more inclined to stick at the lower levels where the work becomes a routine."

"Primarily a masculine field; women viewed with suspicion. But real work receives recognition."

"It seems to me that added responsibility and better positions are usually forthcoming to those willing to take a real interest in their work and devote themselves to it wholeheartedly."



"The limitations lie in women not in the job. Because they are so unstable and generally seeking a job for but a few years, men hesitate to put them in positions of trust and responsibility, and statistical work means both."

Several comments from men statisticians may be added; they represent the open-minded attitude which has been generally met within the profession in the course of this study. The first is from the chief statistician in a state industrial commission:

"As for the chances for women in such work, I believe they were never better than today because the demand for trained and capable statisticians was never so great as now both in public and private employment. So far as I can see, it is a profession to which women are naturally as well adapted as men and I can see no reason why women who develop capacity may not succeed as well as men."

The following comments are from statisticians in business:

"The war broke down the barriers for women; there is no end of opportunity for the statistically minded, both in routine positions and in higher positions (especially in the fields of business and financial research) for the specially gifted and those with initiative. The demand is growing."

"Statistical work is becoming so generally a part of all large business organizations that it offers a wide and varied field for the college woman. The statistician must be a good mathematician, economist and analyst if she expects to reach the higher positions, but there are many grades of work in this field that are attractive to the average college woman."

"It seems necessary for the sake of permanency and flexibility of organization to have the backbone of any large statistical organization made up of high-grade college men. On the other hand, there is a growing number of openings for trained women statisticians to take charge of the statistical work in smaller organizations and such openings afford a natural ultimate line of advancement for those who have gained experience, with larger concerns. In other words, the greater the gamble the greater the reward—or the less! There is a real point with regard to occupational selection here—one should think and choose carefully which type will bring the most satisfaction in the long run."

From his varied experience in statistical work Dr. Leonard P. Ayres has written:

"Statistical work always demands the services of a large number of people who do little more than high-grade clerical work

and a small number of people who bear the responsibility, do the thinking, decide the form, and draw the conclusions. The field is free for all and it is one in which pull, money, social status, and personal preferments have relatively little importance. Those who have statistical ability and are able to present their material in written form so that it carries conviction and will stand close analysis and scrutiny, ultimately hold the high positions. It is very seldom that women statistical workers are willing to undertake the independent effort that is necessary to acquire this skill. They appear to have the ability and are doing much if not most of the hardest work that is done in the profession but they seldom make any new contribution or attempt to write statistical articles of even a modest sort."

Dr. Ayres thinks it important to point out "to the young woman who is entering this work that she must first go through her apprenticeship of contact and participation, and that after she has mastered the technique she must begin to write statistical articles and publish them if she ever wants to rise to the higher positions of the profession. The men have to travel that hard path and the women must, too, if they expect to reach the top. At the present time I think that a majority of the statistical workers of America are women and I think that their participation in the professional associations is almost negligible and there are no books and practically no articles on statistical methods written by women.

"I should think that the qualities needed for successful work in statistics were the following:

- aptitude for numerical study
- general education
- ability to write
- skill in simple mechanical drawing
- training in statistical technique.

The girl who has the first two ought to be able to acquire the last three if she will put as much work into them as do the men with whom she is competing and in that case she ought to be equally successful."

The conclusion is justified that for the woman with a wide interest and trained intelligence in the economic and social matters of the day and subordinate to these, a sense for facts and for quantitative analysis, statistical work offers a broad and fairly uncharted field in which she may make of her ability and interest what she will.

### QUALIFICATIONS REQUIRED

No attempt has as yet been made by psychologists to isolate the qualities essential to success in statistical work, and any present statement can only be a practical generalization of experience. The variety of more or less specialized positions grouped under statistical work has been described; there are certain qualifications corresponding in a general way to their requirements. "General intelligence" is emphasized by employers and workers alike as the *sine qua non* for any kind of statistical work.

Dr. Edmund E. Day has written, in regard to the varieties of positions in statistical work:

"Statistical work assumes a number of different phases which call for essentially different qualifications. The result is that women possessing ability along very different lines may find satisfactory openings in statistical service. There is a world of difference between the work of a computer and that of an editor of statistical reports, and a skilled tabulating machine operator may be quite unfitted to serve as a clerk editing incoming schedules. It is a rare woman who can do equally well the different varieties of statistical work, and in statistical work as elsewhere specialization tends to increase as the service develops. It does not seem to me wise to suggest that as a rule the various positions are all stepping stones to the position of statistician; there are excellent openings all along the line and there are large enough differences among the different lines of work to afford opportunities for every variety of capacity."

*Subsidiary Work.* Whatever other qualities she may have, the operator of computing and tabulating machines must be accurate, deft and patient and must have the intelligence to understand in a practical way the highly specialized and delicate machines used in statistical compilation and tabulation. Patience and exactness with neatness are necessary qualities for the statistical draftsman also; she must take pleasure in painstaking work with fine discriminations. Her mind does not need to be limited to the requirements of drafting, and the more she learns of the material with which she works and its significance, the more interesting and effective her work may become.

The supervisor of a division of statistical computers or clerical workers must have executive ability to plan and assign tasks, estimate quantity and quality of output, recognize ability and develop esprit de corps. She must know at first hand and from experience the work of her division.

For the field investigator the desirable qualities include first a zest for getting information coupled with the ability to recognize the desired information and to discriminate between fact and opinion. She must be adaptable to various conditions, and able to meet people readily; she needs initiative, tact and judgment. The investigator's value is increased by the extent of her knowledge of sources from which the desired information may be drawn, and by the extent of her comprehension of the problem in hand. The routine investigator who goes forth to prescribed sources with a prescribed schedule must still have tact in meeting with people, judgment in selecting information and a good knowledge of the subject of investigation.

The editor of statistical material needs primarily the ability to write clearly and skill in organizing subject-matter. This at once involves, in this field, interest in the statistical presentation of facts and some acquaintance with statistical methods. She must have a good background and intelligence, with versatility for becoming familiar with the material she organizes.

For all of the subsidiary work so far included an important requisite is the ability and readiness to recognize and co-operate with leadership.

*Professional Work.* For planning and directing investigations and for the important final work of interpretation and reporting, clear thinking, imagination, vision, good judgment, with a sense of proportion, are fundamental. Good organizing ability, definiteness in method, absolute clearness of thought as to the use and significance of reports are necessary to insure timeliness as well as utility. Imagination and judgment, depending upon broad knowledge, make the essential difference between routine and scientific work in statistics. Expansive general intelligence with intensive zeal for exact facts, and knowledge of their practical use, interest in quantity, patience, versatility; a more than usual degree of personality and initiative; and above all a scientific love of truth characterize the statistician.

As in all other fields of work, seriousness of purpose, a long plan for the development of such purpose, and in general an interest in and professional conception of the work are fundamental for progress and service.

## ADVANTAGES AND LIMITATIONS

*Advantages.* The advantages that are pointed out as adhering to all kinds of statistical work are general; such work is ordi-

narily done in higher class organizations, therefore, the hours and surroundings are apt to be correspondingly agreeable and the associations with other workers stimulating. In all but the most routine positions there is the satisfaction of being engaged with present-day problems and in many even of the subordinate positions the opportunity of gaining a broad view of them if one will. In many subordinate positions also, as well as in the responsible ones, the work is stimulating mentally and offers opportunity for exercising initiative and for developing judgment. A statistical department is a strategic unit of administration and therefore offers a vantage point for learning to know the whole organization of which it is a part.

In field work there is opportunity for wide and varied observation and contacts; it is also pointed out, however, that opportunity for direct and sympathetic contact with people is limited in statistical work; hence women who have a great human interest in people and a love for serving them individually would probably feel a certain emptiness in the seclusion necessary for research and analytical study.

The statistician has the satisfactions both of the scientist and the practical man of affairs. As a scientist he works independently, with unlimited chance for growth, frequently making important discoveries, developing improved methods; because of the social character of his data, he is concerned in his investigations with current human affairs and sees the prompt application to practical life of the facts he has made available and interpreted.

*Limitations.* The chief limitation lies in the danger of extreme specialization; many positions offer only monotonous work, in others there lies the temptation to ignore the larger aspects of problems in magnifying the routine phase of the work, because of the endless possibilities of analysis and tabulation of data. A detailed tabulation may be carried through and the results prove to be of no use. The work is tiresome and impersonal unless the statistical worker can see the end in view and is engrossed in that end—the meaning of the figures she is handling. But while one's activities in statistical work may be limited in that the same kind of statistics is done from day to day, they need never really become routine because new phases of problems always arise. The work may tend to become academic and detached, but this is again a matter of temperament and ability to grasp a whole situation rather than to become lost in the details.

## HOW POSITIONS ARE SECURED

*Government.* In regular Federal Government departments positions are filled chiefly by civil service competitive examinations. These examinations are open to both men and women, although the chiefs of departments reserve the right to specify "male" or "female" in making their selection from the highest three on the list. Information in regard to the examinations of the Civil Service Commission may be secured from the main office in Washington or from local offices which are usually located in customs houses or post offices. Positions not under the civil service are filled by appointment and depend upon the superior officer's knowledge of or acquaintance with suitable candidates.

Most state and municipal government positions are also under local civil service administration; they are filled by competitive examination of the state or city civil service commission and appointment by the department.

*Private.* As has already been indicated, there are various entrance positions which may lead to statistical work. Seventy-seven women now engaged in statistical work have indicated for this study what their first salaried position was. The following is a summary of these reports:

Teaching .....	25
Statistical clerk or assistant.....	18
General clerical worker.....	5
Stenographer .....	5
Field investigator .....	5
Computer .....	4
Research assistant .....	4
Editorial assistant .....	3
Statistical draftsman .....	2
Newspaper worker .....	2
Actuary's assistant .....	1
Social case worker.....	1
Y. W. C. A. worker.....	1
Librarian .....	1
Total.....	77

It should not be inferred that any one of these kinds of work is an equally logical stepping-stone to a position in statistical work although any one of them may have given useful general prepara-

tion for it, and in many of them some practical technique could be acquired. The inference is rather that in this field as in others women have often arrived by chance rather than by design. With this, however, must also be considered the formative character of statistical work as a vocation.

Eighty-four of the women who contributed information for this study reported the means through which their present positions in statistical work were secured, as follows:

Civil service competitive examination.....	18
Recommendation of a friend.....	14
Personal application .....	13
Business acquaintance with employer.....	13
College appointment bureau or department.....	10
Recommendation of former employer.....	9
Advertising .....	4
Professional appointment bureau.....	3
<hr/>	
Total .....	84

A few of the comments made by these women are suggestive:

"A master's degree helped me to secure the first two positions and previous experience the third."

"My unprinted but typed and bound research reports were more helpful than any other single item in seeking a position."

"I was selected from among twenty-five applicants because of my college training."

College departments of economics, sociology, education and psychology frequently can recommend their graduates for positions. College appointment bureaus are in even a stronger position to render this service to the graduating classes and *alumnæ*. The collegiate bureaus of occupations in various centers not only fill the positions of employers who apply to them but frequently seek openings for qualified applicants. There are some other employment agencies, public and private, which occasionally fill positions in statistical work, and such positions are sometimes listed in newspaper and periodical advertisements.

Ordinarily, however, under present conditions, direct application to possible employers is the most successful method to pursue in seeking a position in business and private organizations. A recommendation from an instructor, college bureau or former employer is of material assistance and they are usually glad to recommend a student or employe who has done good work. If a

personal introduction can be secured it is of great advantage. The personal equation is an important one and employers prefer to fill vacancies with candidates whom they know or of whose qualifications they are assured by mutual acquaintances. An employer is apt to consider that a person who shows initiative in one direction will show it in another also, and is therefore generally willing to give anyone a chance who is convincing and can show that she knows how to attack a problem—even the problem of job hunting.

## SALARIES

### GOVERNMENT

In Government work entrance salaries are low and are too apt to remain so. The best that a woman has usually hoped for is a position in a supervisory capacity, at a salary of approximately \$1,800. This applies to the permanent departments which have only definite appropriations providing for statutory positions, rather than to the departments which have "lump sum" appropriations, permitting salary increases at the discretion of the chief of the bureau or department.

In estimating the salaries in the Federal Government it must be kept in mind that Congress is at present considering several measures for the reclassification of the civil service and the revision of salary and promotion scales. A comprehensive salary scale for Government service is that recommended in the report of the Congressional Joint Commission on Reclassification of Salaries, March 12, 1920. Positions in statistical work are listed as follows:

#### Mechanical Tabulation

Assorting Machine Operator.	\$1,140	\$1,200	\$1,260	\$1,320
Tabulating Machine Operator	1,200	1,260	1,320	
General Tabulating Machine Operator .....	1,560	1,620	1,680	
Supervisor, Tabulating or Assorting Machine Section...	1,560	1,620	1,680	
Mechanical Tabulation Examiner .....	1,440	1,500	1,560	
Supervisor, Mechanical Tabulation Examining Section..	1,800	1,920	2,040	2,160
Principal Mechanical Tabulator .....	1,980	2,100	2,220	2,340
Chief Mechanical Tabulator..	2,400	2,520	2,640	2,780
Card Punch Operator .....	1,200	1,260	1,320	
Supervisor, Card Punching Section, Bureau of Census, Bureau of Markets, Bureau of War Risk Insurance...	1,560	1,620	1,680	



**Mechanical Tabulation**

Special Card Punch Operator	\$1,320	\$1,380	\$1,440	
Supervisor, Special Card Punching Section, Bureau of War Risk Insurance.....	1,620	1,680	1,740	1,800
Mechanical Tabulation Coder	1,200	1,260	1,320	
Special Mechanical Tabula- tion Coder .....	1,320	1,380	1,440	
Supervisor Mechanical Tabu- lation Coding Section.....	1,560	1,620	1,680	
Junior Mechanical Tabulation File Clerk .....	1,140	1,200	1,260	
Supervisor, Mechanical Tabu- lation File Section.....	1,560	1,620	1,680	
Special Mechanical Tabulation File Clerk .....	1,320	1,380	1,440	
Supervisor, Special Mechan- ical Tabulation File Section	1,560	1,620	1,680	

**Statistical Clerical Work**

Under Statistical Clerk.....	1,260	1,320	1,380	
Junior Statistical Clerk.....	1,440	1,500	1,560	
Senior Statistical Clerk, Agri- culture, Finance, Transpor- tation .....	1,620	1,680	1,740	1,800
Principal Statistical Clerk, Agriculture, Finance, Transportation .....	1,980	2,100	2,220	2,340
Head Statistical Clerk, Cotton Production, Transportation, Vital Statistics .....	2,400	2,520	2,640	2,760
Chief Statistical Clerk, Agri- culture, Foreign Commerce, Vital Statistics .....	2,820	2,940	3,060	

**Statistical Science**

Junior Statistician .....	1,800	1,920	2,040	2,160		
Assistant Statistician .....	2,400	2,530	2,640	2,760	\$2,880	\$3,000
Associate Statistician .....	3,240	3,360	3,480	3,600	3,720	3,840
Statistician, Population, Transportation, Vital Sta- tistics .....	4,140	4,320	4,500	4,680	4,860	5,040
Senior Statistician, Popula- tion, Transportation, Vital Statistics .....	—	—	—	—	—	—
Director of the Census .....	—	—	—	—	—	—

Any woman who passed the civil service examinations for these positions would be eligible for appointment. Experience in a Government department is to be valued as excellent training.

In the New York City budget for 1919, the following is the standard classification for "statisticians" with the corresponding salaries:

Grade 1 Junior Statistician .....	\$1,200 - \$1,800
" 2 Assistant Statistician .....	1,980 - 2,820
" 3 Statistician .....	3,060 - 3,840
" 4 Chief Statistician .....	4,140 - 4,740

Thirty women holding Government positions, federal, state or municipal, in statistical work, reported their salaries for this study. The number is too small to warrant definite conclusions and the following list of these salaries, with the statement as to experience and training, can only serve as general information concerning a number of individual experiences.

**SALARIES OF WOMEN IN GOVERNMENT POSITIONS WHO  
REPORTED FOR THIS STUDY.**

Salary	Years of experience in related work	Training			
		College	Non-College	Special	Business
\$900	1	x			x
1,100	1	x			
1,300	6		x	x	x
1,320	3	x		x	
1,320	4	x			
1,350	2		x		
1,400	14	x			
1,440	5	x		x	
1,440	2	x		x	
1,440	6		x		
1,440	7		x		
1,440	5		x		
1,440	8		x		
1,500	1		x	x	
1,540	2	x			
1,540	2	x		x	
1,625	4	x		x	
1,640	10	x		x	
1,640	2		x	x	
1,640	11	x			
1,800	7		x	x	
1,800	4	x		x	
1,800	3		x		
1,800	2	x			
1,840	10		x		x
2,040	3	x		x	
2,100	7	x		x	
2,400	1½	x		x	
2,500	No report		x	x	
5,000	20	x		x	

## BUSINESS

In private business organizations the salaries for the statistical clerical positions are generally paid on a weekly basis instead of on a per annum basis as is usual in the Government. The most common entrance salary among twenty business corporations proved to be \$20 a week; the highest salary for a statistical clerk was \$39. Salaries for responsible work ranged from \$2,400 to \$5,000.

In the field of insurance the salaries, on the whole, are less, and the promotions do not come as quickly as in other fields. It is the field in which women have advanced perhaps the least, although there is no reason why they should not. Positions are offered to girls with college training at as little as \$10 a week, in some of the larger insurance companies, with small prospect of advancement. This is not even a living wage, but if a girl can afford to consider the experience gained as part of her training and include the cost under "education," it may be valuable to her in the future. There has been observed a recent tendency in business to pay better salaries for this type of work.

In industrial and commercial organizations statistical work is in the process of becoming established and salaries are therefore probably more variable and flexible.

The following list is a summary of the information received in regard to salary from women who are doing statistical work in business organizations.

**SALARIES OF WOMEN IN BUSINESS POSITIONS WHO REPORTED FOR THIS STUDY.**

Salaries	Years	Training			
	of experience in related work	College	Non-College	Special	Business
Manufacturing					
\$1,092	1/6	x			
1,200	2	x			
1,200	3		x	x	
1,500 & bonus	2	x			x
1,560	2	x			
1,680	3	x		x	
1,680	2	x			
1,800	2		x	x	
1,847	3	x		x	
1,872	9		x		
2,000	2	x		x	
2,000	8	x		x	
2,400	1	x		x	

SALARIES OF WOMEN IN BUSINESS POSITIONS WHO REPORTED  
FOR THIS STUDY.*Finance*

1,300	3		x	x	
1,500	2	x			
1,500	31		x	x	
1,500	2	x			
1,800	3		x		x
2,000	2	x		x	
3,500	20		x		x

*Insurance*

1,060-1,400	4		No report		
1,320	2	x		x	
1,320	9	x		x	
1,500	6		x		
1,700	11	x		x	
1,800	2	x		x	
2,080	3	x		x	

*Advertising*

2,700	4	x		x	
5,000	3	x		x	

*Trade Associations*

1,500	1½		x	x	
3,000	3	x		x	

*Statistical Service Organizations*

1,040	2		x	x	
1,200	3	x			
1,400	2	x			
1,400	2	x			x
1,500	3	x			x
1,600	26	x		x	
5,000	8	x			

## EDUCATIONAL AND SOCIAL WORK

In educational and social work women are in general better established; the salaries women are receiving in these fields are therefore more apt to represent the usual salary range for this kind of work. Fewer salaries have been reported from these fields than from any other; they are as follows:

**SALARIES OF WOMEN IN EDUCATIONAL POSITIONS WHO  
REPORTED FOR THIS STUDY.**

<i>Salary</i>	<i>Years of experience in related work</i>	<i>Training</i>			<i>Business</i>
		<i>College</i>	<i>Non-College</i>	<i>Special</i>	
\$1,020	2		x		
1,500	1	x		x	
1,500	2		x		
1,560	1	x			
1,600	6	x		x	
1,800	1	x		x	
1,800	2	x		x	
1,875	4	x			
2,400	10	x		x	
2,400	4	x		x	
4,000	20	x		x	

**SALARIES OF WOMEN IN SOCIAL WORK POSITIONS WHO  
REPORTED FOR THIS STUDY.**

\$1,260	3	x			
1,430	2	x			
1,530		x			
1,800	1	x			
2,000	3	x		x	
2,000	4	x		x	
2,400	9	x		x	
3,000	11	x			x

## PART VII.

### Sketches from the Experience of Women in Statistical Work

**T**HE following brief summary of the experiences of a number of women engaged in statistical work may serve to illustrate in a number of ways the preceding discussion of positions, fields of work, preparation and opportunity for women in this field as these various aspects present themselves concretely in the career of an individual worker. These sketches illustrate also the conclusion that only in few instances have women as yet attained to the professional rank of statistician; in practically every situation cited, however, there is inherent the possibility of development to larger responsibility.

#### GOVERNMENT

A high school graduate was employed to do general stenographic work for a state commissioner of health, and was later assistant state registrar for two and a half years. After a semester course in vital statistics in a school of public health, she was promoted to be the head of the state bureau of vital statistics, where she has charge of the collecting, classifying and tabulating of the birth and death statistics of the state. Her present salary is \$1,800.

She comments: "It seems to me that statistical work is in its infancy and I do not see why women cannot be successful in it. One comes in contact with a splendid class of people in public health work. As I am in entire charge of the bureau its success or failure depends upon my initiative. From the fact that in most states these appointments are political it is hard to estimate the opportunity that women would have in this work."

In another state a woman's first position was a temporary appointment to do some special statistical work for the health department, which was then in process of reorganization. She was a college graduate who had specialized in languages and advanced mathematics and had studied economics, social science, accounting and statistics. Because of her training and satisfactory work, she

was retained permanently as a statistician. The position was under civil service, but since there was no eligible list she was previously appointed and a special examination was requested for her. She took some special courses on the side in demography and business statistics. After three years and a half she left to take charge of statistical work and office in the state minimum wage commission. She is officially called "senior clerk." She arranges and plans the statistical work of the commission and is responsible for all final checking. She personally does a small part of the investigation and gathering of data also.

Her discussion of her two state positions suggests various considerations: "First of all it should be borne in mind that my range in salary (\$720-1,440) in four years would scarcely be typical in a real business office. Increases in state work depend not on what your superior believes you to be worth but upon your initial salary, length of service, appropriations, and the final decision of a body of men who know you only through written recommendations. It is to their interest to spend as little money as possible rather than to retain efficient workers. In my own case, when I left the Health Department to take another position in state work at a salary \$300 higher, the health commissioner was glad and willing to give me the same amount in order to retain me, but by law was unable to make any change in my salary for six months, and even then could not guarantee to obtain the amount for which he had recommended me.

"This position had much more opportunity for original work since I had developed it and had it been an ordinary business concern I should not have considered making the change even for the larger salary offered.

"The statistical work of the Minimum Wage Commission is carried on in a pre-arranged manner—that is to say, from the original records the same tables and analyses are made for each investigation. The one advantage over the other position is that the statistician works from records obtained by herself or under her direction. However, after one or two investigations the work becomes rather automatic. . . .

"I feel that training such as I have had is excellent for one interested in statistical work. . . . I understand that the field is comparatively new, in which case much depends on the pioneers."

A very different course of progress into statistical work was that of a statistical clerk in the United States Department of Agriculture. After completing high school and one year of college with

a course in accounting she was first a bookkeeper in a manufacturing plant, then office assistant in an auditor's office. She took some work on the side in business law and banking and heard lectures in economics and statistics. On passing a competitive civil service examination she was appointed to her present position, in which she has charge of a statistical section of agricultural geography.

She feels that some experience which will make one accurate and able to handle other people is essential preparation for the work she is doing; that to be a *statistician* a woman would have to have university training in other subjects in addition to work in statistics.

For her present work in analyzing and tabulating cost accounts and price data sent in by various industries for the United States Tariff Commission, a woman secured her special training on the job. She was a college graduate with the degree B. S. and the experience of fifteen years of teaching as her general background.

"When the need for workers was great I became a member of the price section of the War Industries Board, whose chief was the authority in this country on price statistics. I had never done statistical work but I found that my general training was a great help. I did investigative and analytical work, tabulating, computing, in fact helping out where needed.

"Later I joined the staff at the Tariff Commission and am assistant to the chief cost accountant. I take the cost reports sent in by the various firms, study them, analyze the different items, tabulate them, check them, watching for inconsistencies and discrepancies. I find it very interesting but wish I had had training in statistical methods.

"Training along the line of price statistics or production statistics and a keen appreciation of statistical methods will always find recognition, I believe.

"Statistical clerks in the Government seem too often to have little initiative or chance for it and to find their work dull and uninteresting. I like mine and believe in it."

A woman employed as "statistical clerk" in the Bureau of Foreign and Domestic Commerce writes up statistical material for publication in Commerce Reports and for trade journals and press publicity purposes. She had a business course after high school and held various stenographic and other clerical positions. She entered the bureau by a competitive civil service examination,



where for some years she was a correspondence clerk, handling all correspondence on one particular industrial subject, and taking charge of the files.

"I have done the usual tabulation, compilation, and adding machine work of the division in the past, and have to be familiar with it in order to secure the figures I require in writing the stories. One has to comply with certain hard and fast rules, such as eliminating all except absolutely necessary adjectives; no opinions of any kind may be stated and no information other than from government sources may be used; text must conform to straight statistical facts and nothing else.

"A knowledge of all commodities in commerce is necessary, as well as of transportation, cost of living, sociology in other countries, labor and wages—in fact, everything that affects the prices of commodities in the commerce of the world."

A woman working in the Department of Agriculture majored in economics and sociology in college, including work in statistics. "My course in statistics, of course, gave me a general insight into statistical methods, but I feel my whole college training contributed to the broader point of view which has made my present work possible. I believe a college education can alone give the necessary foundation for the intelligent handling of statistics in relation to present social and economic conditions. One must have a broad outlook and general intelligence which sees through and beyond the figures into the facts and conditions which they symbolize."

This worker spent one summer vacation as clerk in the editorial department of the Bureau of the Census and after college became statistical clerk in the Bureau of Markets, from where she was transferred to her present position. She is in charge of the office work, statistical, editorial and general, in connection with an investigation in agricultural insurance.

"My work at present has departed considerably from the purely statistical field in that it includes research work concerning the insurance laws of the United States and foreign countries, editorial work in the preparation of statistics and manuscripts for publication and general planning and supervision of the office activities on all lines.

"In the narrow sense, i. e., the mere tabulation and computation of figures, it is drudgery; in a broader sense it is interesting work.

"There seems to be an ever increasing demand for statistics in all lines of investigation. Advancement in positions depends en-

tirely upon the ability and self-assertion of the individual; men still have the advantage."

#### BUSINESS

*Manufacturing.* A college graduate with a science major became research assistant to a professor of science, then statistical research worker in the United States Shipping Board. She is now research assistant to the trade adviser of a large manufacturing corporation. She compiles statistics which are used as a background for judging the present rate of business increase, abstracts all notices in current publications which give information for possible sales, etc., and records all significant information wherever found. She supplies the interpretation for all her own data. She recommends as preparation for the kind of work she is doing a background of general information, including a knowledge of geography and foreign economic conditions, with a university education including mathematics, English and foreign languages.

In another industry a woman is head of the graphic department, making graphs of every phase of the business and analyzing them for the executives, as well as compiling the necessary data. She has to understand all departments in a general way in order to make her own department function properly; she therefore has access to all departments and records. Her training has been a college course with major work in mathematics and science. She advises for a "good solid foundation" a general education with a good knowledge of mathematics. She had taught six years after college, and had been ledger clerk in a manufacturing plant.

In a firm of consultants and engineers in industrial personnel, a woman is engaged in industrial research. She graduated from college and has done considerable graduate work in mathematics, educational psychology and statistics. She has taught science for five years and been statistician and business manager for a psychological and sociological research laboratory in connection with a public institution.

In her present position she tabulates and interprets mental test records and various scales and has done some work on trade tests. She assists in studies of wages, labor turnover, etc., making her own interpretations. A detailed report is made to her chief and significant points are issued in bulletins to clients. It is her experience that members of the staff tend to become specialists and entirely responsible for the work in their specialty. She recommends

the experience to be gained in working with a good statistician as well as a good general course in statistics. Knowledge of how to operate machines she also considers a useful item of equipment. Patience, accuracy, and the ability to observe are essential general qualifications.

*Banking and Finance.* A woman who is financial statistician in an investment house started as secretary to the vice-president at \$17 a week, a position which required stenographic skill and a knowledge of statistics. Bit by bit she reached out for the statistical work until she had built up a separate department. Within a year she had attained a salary of \$2,500. She explains that this would only be possible with a young and developing corporation but she feels there is a constantly and rapidly increasing field for women as financial statisticians with unlimited opportunity for advancement, although as yet there is a salary discrimination against them.

In her judgment the statistician should have a mathematical background; this does not mean higher mathematics, necessarily, but rather a liking for figures, an analytical mind and absolute accuracy. In an investment and security house the work is chiefly tabulating, computing and projecting—graphs are rarely used except when it is necessary to publish the results for the benefit of the layman.

A statistician in another investment house is engaged not in purely statistical, but in more general economic research, writing industry reports or analyses of the economic status of various basic industries in whose securities her house is interested. Her college specialties were economics and English with work in statistics, accounting and modern languages. She advises a background of natural sciences both for the sake of the subject matter and for training in scientific thinking, as well as a study of statistics, economics, commercial geography, foreign languages and English. Higher mathematics she does not deem necessary.

*Insurance.* A teacher of mathematics in high school became after ten years assistant to an actuary engaged in rate-making for casualty insurance. Her college work, which was extended to cover the requirements for a master's degree, had included statistics, mathematics, accounting and insurance. Her university recommended her for this position. The experience of various companies is compiled in her office and this compilation serves as a

basis for solving the problems of rate-making, principally for workmen's compensation insurance.

*Advertising.* With a doctor's degree in economics and sociology, a year's work as chief of a section in the United States Food Administration and special experience in the United States War Industries Board, a woman has become head of the department of statistics and investigation in an advertising firm, where she is in charge of planning and carrying through all kinds of investigations relative to products advertised by the firm. She is responsible for a large variety of statistical reports, whose form she is working to standardize. She has had no formal training in statistics but a lively interest in methods of statistical presentation.

#### STATISTICAL SERVICE ORGANIZATIONS

A college graduate with work in advanced mathematics, biology and economics and a course in stenography has been statistical clerk in a public utilities corporation, in the United States Shipping Board, and in a manufacturing plant. She is now supervisor of statistical work and the files in a statistical service organization which compiles business information and forecasts business conditions. "The work naturally covers a wide field and is exceedingly interesting. At the present time I am responsible for the files and am trying to systematize the filing methods. Files usually go hand in hand with statistics, especially in small organizations, and it is desirable that a woman going in for statistics should be familiar with efficient filing methods. It is a simple thing, however. My knowledge of filing has been picked up through observation and practical experience.

"I also supervise several boys who are employed as statistical clerks. I will give an example of my role in the organization. The various men turn over the jobs which they want done to me. One man will tell me that he wants index numbers of the purchasing power of a pound sterling in England and the United States for a certain period. Perhaps he will tell me sources for figures which I need to work with and perhaps he will not. I plan and figure out the problem, assign it to one of the boys and show him how to do it.

"I think that statistics is a very good field for a woman who is adapted to it, but to be successful she must be a clear thinker. She must be the kind that does original problems in algebra and geometry easily and who likes economics. She should also have initiative. The demand for statistics has grown rapidly in the last

few years and is still growing rapidly but good positions are not as yet very plentiful and it is up to statistical workers, especially women, to make a place for themselves. I should advise a woman to get her first statistical experience in a large, efficiently run department, and while in such an organization to use her powers of observation. After two or three years in a large organization a woman who enjoys taking initiative and depending upon herself would find it more interesting and perhaps more profitable eventually to assume responsibility in a small organization. The field of manufacturing statistics is, I think, the most difficult and the least promising for a woman. These statistics usually require a working knowledge of cost accounting and often involve a certain amount of factory systematizing."

#### EDUCATION

In an organization devoted to educational research a woman is employed to do mental testing, to prepare the statistics and charts tabulating the results, and to prepare the material for publication. After graduating from college with considerable work in mathematics and social sciences, she completed the work required for a master's degree, specializing in education and mathematics. She believes that this second degree helped her secure her first two positions, as assistant in a college psychological laboratory and as assistant in statistics in a special piece of psychological research work; and that she was selected for her present position because of the experience she had gained in the first two. Her present work requires considerable initiative and responsibility.

#### SOCIAL WORK

A varied preparation, normal school, college, business school and a course in actuarial science, and an equally varied experience in the United States Bureau of Labor, the Census Bureau, as assistant superintendent of a reform school, field secretary for a state tuberculosis society, special agent for the Children's Bureau, and statistician for the United States Shipping Board, have formed a valuable background for a woman who is establishing a research department in an important national health organization. She is responsible for the preparation of all schedules, questionnaires, etc., used by any department and carries out independent statistical studies in which she is entirely charged with the interpretation of her data. She has written a report on infant mortality, prepared

a handbook to be used in making surveys, and completed an investigation of the economic cost of one prevalent disease.

She majored in mathematics in college, and took work in economics and social science. She has a good knowledge of three modern languages. Statistical methods she learned by experience.

A logical mind, straightforward diction, capacity for hard and sustained work and a mind for detail are the qualifications she emphasizes as requisite for this kind of work. She feels that statistical work for women has just begun to open up and that there are great possibilities in it, although the chances for men are still better.

## PART VIII.

### Summary

1. *The Nature and Use of Statistics.* Statistics are quantitative statements of facts which have been scientifically collected and arranged for purposes of comparison. The significance of a careful analysis of facts is increasingly recognized as a guide to policy in government, business, education and social work. As a science statistics has a history, a body of literature, underlying principles governing statistical method.

2. *Statistical method* is made up of the processes, governed by definite principles, which are involved in (a) collecting, (b) analyzing and organizing, (c) interpreting and presenting statistical facts. Statistical methods are employed not only in economic and social problems but also in science and engineering.

3. *Kinds of Positions in Statistical Work.* In statistical work there are many subsidiary positions which may be highly specialized—machine operator, computer, draftsman—especially where large enumerations are made. Some subsidiary positions such as editor, accountant, field investigator and in some instances clerk, carry with them a considerable degree of responsibility and offer opportunity for excellent experience. Statisticians carry full responsibility not only for planning and carrying on investigations but for the culminating task of interpreting the results.

4. *Fields in which Statistical Workers are Employed.* *Government departments.* There are statistical divisions in practically every government department. In them are compiled regularly basic cumulative statistics of population, education, agriculture, industry and commerce. Special investigations are conducted in addition and results published. Annual reports of departments contain important statistical data.

*Business.* Manufacturers conduct research for the improvement of processes and of product, for greater efficiency in internal management, for development of markets and sales, for intelligent handling of all matters pertaining to workers. Banks and invest-

ment houses study demands for capital and all matters related to domestic and foreign finance and commerce. Insurance has always depended primarily upon statistical data, particularly in rate-making. Accountants analyze and present graphically the business facts and relations included in their records. Advertising agencies and departments analyze facts that influence business, in order to discover principles of procedure in advertising and advising patrons. Graphic methods are largely used in illustrating advertisements. Merchants analyze internal records and external facts affecting trade. Trade associations establish statistical departments for collecting, summarizing and distributing to their members data in regard to such industrial and commercial factors as influence the trade they individually represent. Trade, commercial and financial papers require some staff members prepared to do statistical work.

*Statistical Service Organizations.* There have recently grown up a number of organizations particularly devoted to the purpose of securing and distributing statistical information on all phases of business conditions and making business forecasts.

*Educational Agencies.* Departments of education and psychology and private organizations increasingly make scientific studies of various factors of school administration, and statistical comparisons of the psychological aspects of education. Public school departments employ statisticians. There is considerable opportunity for teaching statistics; in a few instances supervisors of statistical laboratories are employed.

*Social Agencies.* A beginning has also been made in applying scientific methods in analyzing the complex social facts other than those involved in the problems of education. The more important social agencies are introducing statistical departments; in others records are compiled by clerical employees, or statistical workers are temporarily engaged.

5. *Preparation for Statistical Work.* For subsidiary positions in statistical work clerical training or the acquisition of a certain special skill—machine operating, computing, drafting—is necessary; this may be acquired by experience. For any responsible work in statistics it is evident that training consists (a) in acquiring a comprehension of the principles and methods involved in statistical work and skill in applying them to actual problems, (b) in developing, through a broad education and experience, judgment



in the planning of investigations and in the interpretation and evaluation of results.

A general course in statistics may well be elected as a part of the college preparation, specifically vocational courses in statistics are offered in schools of social work, schools of business, schools of education and in technical schools. Graduate work in statistics is profitably elected in the department of major work.

Judgment in the interpretation and evaluation of data depends as far as training is concerned, upon a broad general education in which a college course, including work in economics, statistics, mathematics, foreign languages and English, is fundamental, and upon a thorough grounding in the subject to which the statistics relate.

*6. Other Vocational Considerations. Opportunity for Women in Statistical Work.* The future for statistical work in general is promising. There are no limitations for women inherent in the work itself; as in other fields the leadership of men has traditionally been accepted. Good work is recognized, however, and for women who are qualified and trained for it and who will enter upon their vocation with professional purpose, statistical work offers good opportunity.

*Qualifications Required.* For the subsidiary tasks involved in statistical work, accuracy, patience, neatness are requisite; for field investigation, ability to meet people, zest for hunting information and judgment in selecting it; for supervision, executive ability; for editorial work, a gift for clear expression. For any statistical worker charged with responsibility interest in quantitative methods and in the scientific pursuit of truth, versatility, good general intelligence are primary. Vision and judgment, implying broad background of training and experience qualify the statistician.

*Advantages and Limitations.* Good surroundings, stimulating associations, opportunity for unlimited development, independent work with results of practical value, these are advantages adhering to statistics. The chief limitation rests in the temptation to become involved in the technique and lose vision and control.

*How Positions Are Secured.* Civil service examinations, federal, state, and municipal, are the usual entrance to government positions. College and professional employment bureaus and advertisements are frequently effective in placing statistical workers, but personal application, recommendation of teachers or employers,

examples of past work are the most useful means to apply in securing a position.

*Salaries.* Because of the variety of positions connected with statistical work the salary range is large. Positions are unstandardized and lines of promotion indefinite. In general, machine operators are paid from \$900 for beginning work to \$1,600 for supervision of a section; statistical clerical work from \$1,000 to \$3,000; statisticians from \$2,000 to \$5,000 to very high salaries for responsible trade advisers.

# Appendix

## I. OPPORTUNITIES FOR TRAINING

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# **1. Courses in statistics which form a part of a more comprehensive schedule in**

## **A. Arts and Science Colleges**

A student can acquire, by electing college courses in statistics which include practical laboratory exercises, a working knowledge of the elementary principles and the technique involved in statistical work and some skill in applying this knowledge and technique to actual data. This will equip her for a statistical clerical position. If she combines the courses in statistics with such electives as will give a background for the field in which she will use her statistical tool, she will be the more equipped to profit from her experience and advance to increased responsibility. For planning investigations and for the most reliable judgment in the interpretation and evaluation of statistical data, experience is essential and broad general preparation important.

Among arts and science colleges, the following offer undergraduate courses of one or two semesters in statistics in various departments, as indicated. These courses are planned primarily as electives in a general course leading to the degree of Bachelor of Arts; in some instances they may be elected singly by a limited number of students. Colleges are starred in which there are also courses for graduates only, or courses planned for graduates and undergraduates.

UNDERGRADUATE COURSES IN ARTS AND SCIENCE COLLEGES IN THE DEPARTMENT OF

ECONOMICS	SOCIOLOGY	EDUCATION	PSYCHOLOGY	MATHEMATICS
Albion College University of Arkansas	Barnard College Brown University	University of Arkansas		*Brown University
Brown University *Bryn Mawr College				
*University of California				
*University of Chicago University of Cincinnati	*University of Chicago	*University of Chicago		Cedar Crest College *University of Chicago *University of Cincinnati
Coe College University of Colorado Colorado College				University of Colorado Colorado College Connecticut College *Cornell University
*Cornell University	Cornell College University of Denver Fisk University	*Cornell University		
Florida State College for Women				
*George Washington University	Goucher College			University of Georgia *George Washington University
Grinnell College				Grinnell College Hiram College

## UNDERGRADUATE COURSES IN ARTS AND SCIENCE COLLEGES IN THE DEPARTMENT OF

ECONOMICS	SOCIOLOGY	EDUCATION	PSYCHOLOGY	MATHEMATICS
University of Idaho	Hunter College			H. Sophie Newcomb College
*Indiana University	Illinois Wesleyan University	*University of Illinois		*University of Illinois
*Iowa University Jackson College				
University of Kansas	University of Kansas	*University of Kansas		*Iowa University
University of Kentucky		Knox College		
Leland Stanford Jr. University		*Leland Stanford Jr. University	*Leland Stanford Jr. University	
University of Louisville				
*University of Michigan		University of Michigan	University of Michigan	*University of Michigan
*University of Minnesota	Miami University			
*University of Missouri Mount Holyoke College	*University of Missouri	*University of Missouri		*University of Missouri
*University of Nebraska		*University of Nebraska		*University of Nebraska

UNDERGRADUATE COURSES IN ARTS AND SCIENCE COLLEGES IN THE DEPARTMENT OF

ECONOMICS	SOCIOLOGY	EDUCATION	PSYCHOLOGY	MATHEMATICS
University of Nevada *Northwestern University	University of North Dakota			University of North Dakota
Oberlin College *Ohio State University	*Ohio State University Ohio Wesleyan University	*Ohio State University	*Ohio State University	Ohio State University Ohio Wesleyan University
*University of Oklahoma	*University of Oklahoma University of Omaha *University of Oregon	*University of Oklahoma University of Omaha *University of Oregon	University of Oregon University of Pennsylvania	University of Oregon *University of Pennsylvania Pennsylvania State College University of the Philippines
*University of Pennsylvania	*University of Pennsylvania	Purdue University Reed College		Rice Institute University of Rochester
*University of Pittsburgh Pomona College *Baylor College				
	Brockford College			



## UNDERGRADUATE COURSES IN ARTS AND SCIENCE COLLEGES IN THE DEPARTMENT OF

ECONOMICS	SOCIOLOGY	EDUCATION	PSYCHOLOGY	MATHEMATICS
Russell Sage College	Smith College	St. Lawrence University University of South Dakota University of Southern California *University of Texas	Syracuse University University of Utah	Smith College University of South Dakota University of Texas
*University of Texas Toledo University Vassar College University of Vermont Washington University *University of Washington State College of Washington	Western Reserve University, Women's College West Virginia University	Western Reserve University, Women's College West Virginia University	University of Washington	Washington University University of Washington State College of Washington Wellesley College
Wheaton College	Willamette University			Whitman College
*University of Wisconsin				University of Wyoming

## B. Vocational and Professional Schools

Courses in statistics in vocational schools are specifically planned for use in the vocation for which the school prepares. They are combined in such schools with other specific courses rather than with courses which give a general background. While planned for the students in a vocational course they are valuable also for the college graduate who has spent his time in college in acquiring a general foundation and has later chosen a specific field of work. A number of the courses listed below have been planned with the graduate student particularly in mind.

In many of the vocational schools, especially the business schools, courses may be elected singly or special groups of courses are arranged to meet the needs of students desiring to spend less than a year in full-time study or to plan a special part-time schedule.

Since the courses in this group are usually items of a more inclusive program, the following classification includes simply the name of the school and the department in which the course is offered with the names of the courses.

### BUSINESS SCHOOLS

#### BABSON INSTITUTE

1. Mechanical Drawing
2. Calculating Machines
3. Graphic Methods
4. Business Cycles
5. Barometrics

#### BOSTON UNIVERSITY

College of Business Administration

1. Business Statistics
2. Mathematics of Statistics and Investments

#### UNIVERSITY OF CALIFORNIA

College of Commerce

1. Statistics in the Service of Business
2. Actuarial Science
3. Analysis of Corporation Accounts and Reports

#### CARNEGIE INSTITUTE OF TECHNOLOGY

Department of Commercial Engineering

Margaret Morrison Carnegie School, Department of Secretarial Studies

1. Statistics
1. Elements of Statistics

- UNIVERSITY OF CHICAGO**  
School of Commerce and Administration
1. Introduction to Statistics
  2. Statistical Theory and Method
  3. Methods of Statistical Presentation
  4. Managerial Accounting
  5. Financial and Manufacturing Costs and Statistics
- COLLEGE OF INDUSTRIAL ARTS**  
Department of Secretarial Studies
1. Statistics
- COLORADO COLLEGE**  
Judson M. Bemis Department of Business Administration and Banking
1. Statistics
  2. Mathematical Theory of Investments
- COLUMBIA UNIVERSITY**  
School of Business
1. Business Statistics
  2. Analysis of Corporation Reports
- DE PAUL UNIVERSITY**  
College of Commerce
1. Elementary Statistics
- DREXEL INSTITUTE**  
The Secretarial School
1. Statistics
- UNIVERSITY OF GEORGIA**  
School of Commerce
1. Statistical Method and Principles
- INDIANA UNIVERSITY**  
School of Commerce and Finance
1. Business and Social Statistics
- UNIVERSITY OF MISSOURI**  
School of Business and Public Administration
1. Statistics and Business Problems
  2. Probabilities and Statistics
- NEW YORK UNIVERSITY**  
School of Commerce, Accounts and Finance
1. Statistical Methods and Application
  2. Business Graphics
  3. Analysis of Corporation Reports
- NORTHWESTERN UNIVERSITY**  
School of Commerce
1. Statistics and Statistical Methods
  2. Business Statistics
- OKLAHOMA AGRICULTURAL AND MECHANICAL COLLEGE**  
School of Commerce and Marketing
1. Statistics

OREGON AGRICULTURAL COLLEGE  
School of Commerce

1. Mathematics of Statistics
2. Elements of Statistics
3. Analysis of Accounts

RUSSELL SAGE COLLEGE  
School of Secretarial Studies

1. Statistics

SIMMONS COLLEGE  
School of Secretarial Studies

1. Elementary Methods of Statistics

SYRACUSE UNIVERSITY  
School of Business Administration

1. Actuarial Mathematics
2. The Mathematics of Statistics
3. Statistics and Sociology
4. Applied Psychology
5. Mental and Social Measurements

TARKIO COLLEGE  
Course in Commerce and Finance

1. Statistics

UNIVERSITY OF TEXAS  
Department of Business Administration

1. Business Statistics
2. Actuarial Mathematics
3. Probability

UNIVERSITY OF UTAH  
School of Commerce and Finance

1. Business Statistics
2. Principles and Methods of Statistics

COLLEGE OF WILLIAM AND MARY  
Graduate Division of the School of Finance and Business Administration

1. Statistics

UNIVERSITY OF WISCONSIN  
Course in Commerce

1. Statistical Method
2. Economic Statistics
3. Prices, Wages and Cost of Living

UNIVERSITY OF WYOMING  
Division of Commerce

1. Statistical Methods
2. Business Statistics

## SCHOOLS AND DEPARTMENTS OF SOCIAL WORK

*Undergraduate*

- BOSTON UNIVERSITY**  
 Department of Religious Education and Social Service
1. Social Statistics and Research
  2. Statistics and Social Diagnosis
- CARNEGIE INSTITUTE OF TECHNOLOGY**  
 Margaret Morrison Carnegie School  
 Department of Social Work
1. Social Statistics
  2. Social Investigation
- FORDHAM UNIVERSITY**  
 School of Sociology and Social Service
1. Social Statistics
  2. Social Research
- UNIVERSITY OF MISSOURI**  
 Missouri School of Social Economy, St. Louis
1. Methods of Social Research
  2. Vital Statistics
- School of Business and Public Administration, Columbia
1. Methods of Social Research
- OHIO STATE UNIVERSITY**  
 College of Commerce and Journalism  
 Social Service Curricula
1. Principles of Statistics
  2. Social Statistics
- PENNSYLVANIA SCHOOL FOR SOCIAL SERVICE**
1. Social Investigation
- SIMMONS COLLEGE**  
 School of Social Work
1. Social Inquiry—Record and Report
  2. Advanced Course in Research
- SCHOOL OF SOCIAL WORK AND PUBLIC HEALTH**
1. Statistics and Social Investigation

*Graduate*

- BRYN MAWR**  
 Carola Woerishoffer Graduate Department of Social Economy and Social Research
1. Seminary in Social Research
  2. Advanced Statistics
  3. Special Problems in Statistics
- UNIVERSITY OF CHICAGO**  
 Graduate School of Social Service Administration
1. Methods of Social Investigation
  2. Social Statistics
  3. Statistical Theory and Method
  4. Methods of Statistical Presentation

**NEW SCHOOL FOR SOCIAL RE-  
SEARCH**

1. Statistical Method
2. Mathematical Theory and Tech-  
nique of Statistics
3. Economic Statistics

**NEW YORK SCHOOL OF SOCIAL  
WORK**

1. Methods of Social Research

**WESTERN RESERVE UNIVERSITY  
School of Applied Social Sci-  
ence**

1. Statistical Methods
2. Statistical Research

**SCHOOLS AND DEPARTMENTS OF PUBLIC HEALTH**

**UNIVERSITY OF CALIFORNIA  
Curricula in Public Health**

1. Statistical Methods and Social  
Economics

**HARVARD UNIVERSITY AND THE  
MASSACHUSETTS INSTITUTE OF  
TECHNOLOGY  
School of Public Health**

1. Vital Statistics
2. Research in Demography

**JOHNS HOPKINS UNIVERSITY  
School of Hygiene and Public  
Health**

1. Introduction to Vital Statistics
2. Advanced Statistical Theory
3. The Statistical Measurement of  
the Effectiveness of Public  
Health Activities
4. Investigations in Biometry and  
Vital Statistics

**UNIVERSITY OF LOUISVILLE  
School of Public Health**

1. Vital Statistics

**OHIO STATE UNIVERSITY  
Department of Public Health  
and Sanitation**

1. Demography

**UNIVERSITY OF WISCONSIN  
Courses in Public Health**

1. Public Health Administration  
and Vital Statistics

**YALE UNIVERSITY  
Department of General Bacteri-  
ology and Public Health**

1. Principles of Vital Statistics

## GRADUATE SCHOOLS AND DEPARTMENTS OF EDUCATION

UNIVERSITY OF CALIFORNIA	1. Educational Statistics
UNIVERSITY OF CHICAGO	1. Statistical Methods, Applied to Educational Problems
HARVARD UNIVERSITY Graduate School of Education	1. Educational Measurement
LELAND STANFORD JR. UNIVERSITY	1. Educational Statistics 2. School Surveys and Measurements
UNIVERSITY OF PITTSBURGH Graduate School	1. Statistical Studies in School Administration 2. Experimental and Statistical Studies in Education
TEACHERS' COLLEGE, COLUMBIA UNIVERSITY	1. Mental Measurements 2. Mental and Vocational Tests and Treatment of Results 3. Application of Psychological and Statistical Methods to Education 4. Advanced Educational Statistics
YALE UNIVERSITY Graduate School of Education	1. Educational Statistics 2. Educational Measurements

## 2. Special Courses in Extension Departments and Evening Schools.

These courses are especially designed for students who are working and want to elect single courses or for those who want to acquire specific information or technique or skill without concomitants. Since these courses form separate units, there is included in the following list with the name of the school, the requirements for admission, description of course, length of course, tuition, and credit.

SPECIAL COURSES IN EXTENSION DEPARTMENTS AND EVENING SCHOOLS

<i>School</i>	<i>Requirements for Admission</i>	<i>Description of Course</i>	<i>Length of Course</i>	<i>Tuition</i>	<i>Credit</i>
BOSTON UNIVERSITY COLLEGE OF BUSINESS ADMINISTRATION Evening Division	Regular students: 18 years of age and high school, or 21 years of age and entrance examination Special students: 21 years of age	1. Business Statistics 2. Mathematics of Statistics and Investments	2 hours each week during second term 4 hours each week during second term	\$17 \$31	30 credit hours 60 credit hours
UNIVERSITY OF CINCINNATI Evening Academic Courses	Matriculates, high school or entrance examination: Special students, 20 years of age and credit for English composition	1. Statistics: Principles of Method and Application to Social and Economic Problems 2. Principles of Analytical Accounting: Analysis and Interpretation	Monday, 5 to 7, for one semester Tuesday, 8:15 to 10	Free to residents and teachers of Cincinnati \$15 to outside teachers, \$10 to others Residents, \$12 per year Non-residents, \$20 per year	2 hours
Evening Courses in Commerce					
COLLEGE OF THE CITY OF NEW YORK Evening Session	Open to mature residents of New York City. Special requirements for candidacy for degree	1. Mental and Educational measurements, including the elements of statistics applicable in computing results of tests and measurements	Clinic: Hours Arranged	\$5	



## SPECIAL COURSES IN EXTENSION DEPARTMENTS AND EVENING SCHOOLS

<i>School</i>	<i>Requirements for Admission</i>	<i>Description of Course</i>	<i>Length of Course</i>	<i>Tuition</i>	<i>Credit</i>
		2. Municipal Statistics: Principles and their application to the problems which arise in city management 3. Public Utilities Accounting and Statistics	2 hours per week, spring term 2 hours per week, one term	\$8 For city employes, \$5 \$10	2 credits 2 credits
COLUMBIA UNIVERSITY Extension Teaching	Special requirements apply only to students who desire to take complete programs in extension teaching Permission of instructor	1. Business Statistics 2. Social Statistics 3. Statistical Investigation: Principles and Methods 4. Seminar: Methods of Sociological study and research. 5. Analysis of Financial Reports	Tuesday, 7:40 to 9:30. Two sessions Tuesday and Thursday, 7:40 to 9:30. Two sessions Monday, 7:30 to 9:30. Two sessions Alternate Monday, 7:40 to 9:30. Two sessions Monday, 7:40 to 9:30. One session	\$16 each session \$24 each session \$24 each session \$24 each session \$24	2 points each session 3 points each session 3 points each session, graduate credit 3 points each session, graduate credit 3 points
DE PAUL UNIVERSITY College of Commerce	18 years of age; regular students, college entrance requirements	Elementary Statistics	Thursday, 7:30 to 9:30. Second semester	\$12	2 hours

SPECIAL COURSES IN EXTENSION DEPARTMENTS AND EVENING SCHOOLS

<i>School</i>	<i>Requirements for Admission</i>	<i>Description of Course</i>	<i>Length of Course</i>	<i>Tuition</i>	<i>Credit</i>
HUNTER COLLEGE Extension and Evening Sessions	18 years of age; matriculated students, college entrance requirements	Educational Measurements: Standard tests and statistical methods involved in treatment of results	One semester	\$6	2 hours
INDIANA UNIVERSITY Extension Division	Evidence of ability to pursue course profitably	Mental and Educational measurements, including a brief survey of elementary statistical methods	One semester	\$9	3 hours
NEW YORK UNIVERSITY School of Commerce, Accounts and Finance	Regular students, college entrance requirements. Special students: 21 years of age and some business experience	1. Statistical Methods and application 2. Business graphics 3. Analysis of Corporation reports	2 hours each term 2 hours second term 2 hours two terms	\$15 each term \$15 \$15 each term	2 points each term 2 points 2 points each term
NORTHWESTERN UNIVERSITY School of Commerce Diploma and Evening Courses	21 years of age, or 18 years of age and high school	Statistics and Statistical Methods	Thursday, 7:15 to 9:15. Two semesters	\$25 first semester \$20 second semester	4 semester hours
SYRACUSE UNIVERSITY Extension Teaching		1. Statistics 2. Analysis of Corporation reports	Tuesday, Thursday, 4:15 to 5:10, first semester	\$10	2 points

## II. SELECTED READING LIST

The contents of the following reading list will give a far more comprehensive conception of statistics, statistical method, and the use of statistics, than has been attempted in the brief statements in this report. The list is suggestive rather than exhaustive; such books have been chosen, in general, as are within the comprehension of the lay person; those which are more technical will nevertheless have many suggestions for those who seek to understand more thoroughly the opportunities in and requirements for statistical work.

### GENERAL

- |  |  |
|--|--|
| Bailey, W. B.<br>and<br>Cummings, John<br>Meitzen, August.   | Statistics.<br>A. C. McClurg and Company, 1917.<br><br>History, Theory and Technique of<br>Statistics, Translated by Roland P.<br>Falkner.<br>American Academy of Political and<br>Social Science, 1891. |
| Journal of the Royal Sta-<br>tistical Society.<br>Quarterly Publication of<br>the American Statistical<br>Association. |  |

### STATISTICAL METHODS

- |                                    |   |
|------------------------------------|---|
| Bowley, Arthur L.                  | An Elementary Manual of Statistics.<br>London, 1910.                          |
| Elderton, W. Palin<br>and Edith M. | Primer of Statistics.<br>London, 1909.  |
| King, Wildford I.                  | The Elements of Statistical Method.<br>The MacMillan Company, 1921.           |
| Secrist, Horace.                   | An Introduction to Statistical<br>Methods.<br>The MacMillan Company, 1917.    |
| West, Carl J.                      | Introduction to Mathematical Sta-<br>tistics.<br>R. G. Adams & Company, 1918. |

### BUSINESS

- |                     |  |
|---------------------|--|
| Babson, Roger W.    | Business Barometers.<br>Babson Statistical Organization, 1913. |
| Copeland, Melvin T. | Business Statistics.<br>Harvard University Press, 1917.        |

- |                     |  |
|---------------------|--|
| Duncan, C. S.       | Commercial Research.<br>The MacMillan Company, 1919.       |
| Mitchell, Wesley C. | Business Cycles.<br>University of California Press, 1913.  |
| Secrist, Horace.    | Statistics in Business.<br>McGraw Hill Book Company, 1920. |

SOCIAL SCIENCE

- |                              |  |
|------------------------------|--|
| Bowley, Arthur L.            | The Nature and Purpose of the<br>Measurement of Social Phenomena.<br>London, 1915.               |
| Chapin, F. Stuart.           | Field Work and Social Research.<br>The Century Company, 1920.                                    |
| Newsholme, Sir Arthur.       | The Elements of Vital Statistics.<br>London, 1892.   |
| Whipple, George<br>Chandler. | Vital Statistics, an Introduction to<br>the Science of Demography.<br>John Wiley and Sons, 1919. |

EDUCATION

- |                 |   |
|-----------------|---|
| Rugg, Harold O. | Statistical Methods Applied to Educa-<br>tion.<br>Houghton Mifflin Company, 1917. |
|-----------------|---|

PSYCHOLOGY

- |                  |   |
|------------------|---|
| Thorndike, E. L. | An Introduction to the Theory of<br>Mental and Social Measurements.<br>The Science Press, 1904. |
|------------------|---|

BIOLOGY

- |                  |  |
|------------------|--|
| Davenport, C. B. | Statistical Methods with Special Ref-<br>erence to Biological Variation.<br>John Wiley and Sons, 1914. |
| Pearl, Raymond.  | Modes of Research in Genetics.<br>The MacMillan Company, 1915.   |

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**PUBLICATIONS**  
*of the*  
**BUREAU of VOCATIONAL INFORMATION**

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**Women in the Law:** an Analysis of Training, Practice  
and Salaried Positions.

Bureau of Vocational Information  
Studies in Occupations, No. 3, 1920  
Price, postpaid, paper bound   **\$.60**  
  cloth bound   **\$1.10**

This report of 140 pages gives information as to the educational requirements for admission to the bar in each state. It analyzes pre-legal training, the training of women lawyers and the law schools of the country, and offers conclusions as to training.

In the discussion of the law as a profession for women there is a summary of what the practice of the law involves, the advantages and limitations of the profession, the personal qualifications required, entering the work, specialization, the time required to become self-supporting, income and the experience of women lawyers to date with illustrations.

Twenty-three pages are devoted to information in regard to occupations other than the practice of the law for which legal training is a preparation.

The appendix includes a table of the law schools which admit women students; a table of the number of women admitted to the bar; a list of civil service positions in the District of Columbia for which legal training is a preparation; a list of bar associations admitting women to membership and of women lawyers' associations.



## **The Woman Chemist.**

**Bureau of Vocational Information**

**Studies in Occupations, No. 4, 1921**

**Price, postpaid, paper bound   \$.60**

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This report, based on material from nearly 400 sources, gives information regarding the varied character and wide scope of the chemist's work. It analyzes the pre-professional or undergraduate training and the professional preparation that is becoming increasingly necessary for ultimate success in scientific work in this profession. The suggestions and conclusions in regard to educational requirements are based on both the experiences and judgments of men and women in this profession.

In the discussion of the four general fields of work, the conditions and prejudices to be encountered by women chemists and the advantages and limitations of the several fields are pointed out. The types of positions and the duties thereof are fully described, and the salary ranges indicated. Sections are devoted to the personal qualities necessary for success, and the methods of securing positions. In addition, there is a general summary of the findings on special points.

In the appendix will be found a list of scientific societies which admit women chemists, and a list of the important fellowships, suggestive of the many opportunities for postgraduate study.

**Positions of Responsibility in Department Stores and  
other Retail Selling Organizations: a Study of Oppor-  
tunities for Women.**

Bureau of Vocational Information

Studies in Occupations, No. 5, 1921

Price, postpaid, paper bound **\$ .60**

cloth bound **\$1.10**

This study contains an outline of store organization and a comprehensive analysis of the positions of responsibility held by women in retail selling organizations. It shows for each type of work the duties, the training and experience and personal qualities necessary, the salaries women are receiving, the advantages and disadvantages of the work and the future which it holds for women. Positions are considered in the four great divisions into which department store work falls—the merchandise, advertising, service and finance departments. More than sixty distinct types of positions are analyzed and discussed.

The report, which is based upon a careful survey of the field, contains information gathered from 387 different sources, and represents the point of view of leading, progressive merchants as well as of the employed women. There are sketches of the experiences of women in department store work, and discussions of positions in allied fields for which department store work may be considered as preparation. The appendix contains an analysis of courses of training for department store executives.

